

Niveau(x) d'enseignement: 8
Centre d'intérêt: 23

Numéro EDUQ : 8170832

Proulx, Pierre-Paul, 1938-.

Cost studies in post-secondary education / Pierre-Paul Proulx. --
[Montreal : Conference of Rectors and Principals of Quebec
Universities], 1971.
90 f. ; 29 cm.,

Comprend du texte en français. "A paper prepared for the Economic Council of Canada Montebello Conference, October 1971". Notes (part. bibliographiques) au bas des p.. Dépouillement partiel: The University of Calgary cost study : summary -- The A.U.C.C. cost study : summary -- John B. MacDonald & Al : le Gouvernement fédéral et l'aide à la recherche dans les universités canadiennes : résumé -- Committee of Presidents of Universities of Ontario, study of engineering education in Ontario : summary -- Conference of Rectors and Principals of Quebec Universities cost study : summary -- Systems Research Group cost and benefit study of post-secondary education : summary.

Cote Dewey: 379.118'09714/P968c

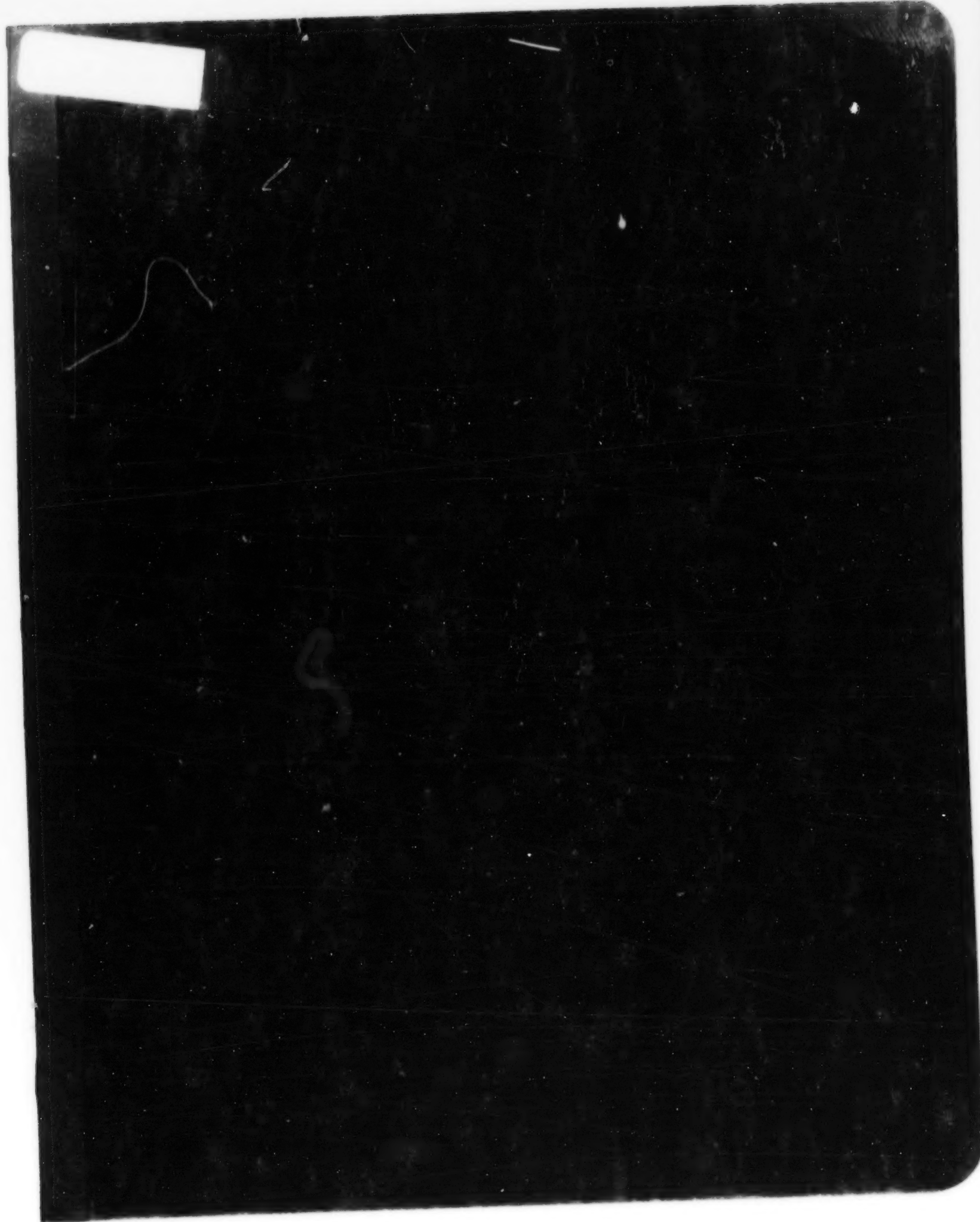
Cote LC: LB/2342.2/.C38

Descripteur(s): *Gestion *Financement *Analyse de coût *Revue de la
recherche *Universitaire (Niveau)

Identificateur(s) de nom: *Canada

Prenant la forme d'une revue de la recherche, le document
entreprend de présenter six études canadiennes de 1970 et 1971 qui
portent sur la gestion de l'enseignement universitaire et plus
particulièrement sur la question de l'analyse de coût et des difficultés
que suscite son application à ce niveau. Les annexes qui constituent la
plus grande partie de l'ouvrage présentent un résumé de chacune de ces
six études.

Type de document: r
Auteur de l'analyse: ar



COST STUDIES IN POST-SECONDARY EDUCATION

Pierre-Paul Proulx, Executive Director
Conference of Rectors and Principals of
Quebec Universities

A paper prepared for the Economic Council of Canada
Montebello Conference.

October 1971

TABLE OF CONTENTS

	Page
1 - INTRODUCTORY COMMENT	1
2 - MAJOR PROBLEMS AND SUGGESTIONS FOR CHANGE AND FURTHER ANALYSIS	6
3 - APPENDIX I * - SUMMARY OF:	
I. THE UNIVERSITY OF CALGARY COST STUDY'	1
II. THE A.U.C.C. COST STUDY	13
III. JOHN B. MacDONALD & AL - LE GOUVERNEMENT FEDERAL ET L'AIDE A LA RECHERCHE DANS LES UNIVER- SITES CANADIENNES	42
IV. COMMITTEE OF PRESIDENTS OF UNIVERSITIES OF ONTARIO, STUDY OF ENGINEERING EDUCATION IN ONTARIO	48
V. CONFERENCE OF RECTORS AND PRINCIPALS OF QUEBEC UNIVER- SITIES COST STUDY	62
VI. SYSTEMS RESEARCH GROUP COST AND BENEFIT STUDY OF POST-SECONDARY EDUCATION	78

* Available upon request from the Economic Council of
Canada

INTRODUCTORY COMMENTS

A growing number of post-secondary education institutions and public bodies have recently terminated, are now pursuing, or are presently planning cost studies. This comes as no surprise, in view of the continued increase in real and money costs of education, in view of the apparent absence of anticipated economies of scale, and in view of financial contingencies which are prompting post-secondary education decision-makers to search for more economy in the processes of learning, research and community service.

This study will focus upon expenditure and cost analyses and neglect discussion of meaningful measures of output in post-secondary education. I hasten to add, however, that financing methods based upon cost analyses only (especially historical costs) are in my view thoroughly inadequate, and that they can only lead to distortions in the allocation of funds.

The study is by no means exhaustive, given the scope of the paper requested and time limitations.

There will be no specific treatment of cost analysis of: trimester operations, co-operative and joint university-industry teaching and research programs, continuing education programs, medical programs, research, bilingualism, emerging institutions, etc. Similarly, no review is made of students' costs in terms of tuition fees, books, transportation, baby-sitting expenditures, foregone earnings, etc.

No attempt will be made to compare the quantitative results of the studies reviewed, because of differences in concepts, methods, and because of lacunae in the data upon which they are based.

Though it is possible to distinguish between individual, institutional, governmental, and social costs, this study will concentrate mostly on concepts, methods and problems, which appeared in the following Canadian institutional cost studies:

- 1) The University of Calgary, Office of Institutional Research, A Proposal for a Cost Study, 1969-70, March 1970;
- 2) A.U.C.C., An Exploratory Cost Analysis of Some Canadian Universities, Ottawa, 1970;

- 3) J.B. MacDonald, et al., The Federal Government and Research Grants in Canadian Universities, Science Council of Canada, Special Study no. 7;
- 4) Committee of Presidents of Universities of Ontario, Ring of Iron: A Study of Engineering Education in Ontario, December, 1970, and more particularly, I.W. Thompson and P.A. Lapp, A Method for Developing Unit Costs in Educational Programs, CPUO Report no. 70-3, December 1970;
- 5) M.D. Segal, The Political Economy of Resource Distribution in Quebec Universities, The Conference of Rectors and Principals of Quebec Universities, November 1970;
- 6) Systems Research Group, Cost and Benefit Study of Post-Secondary Education in the Province of Ontario, School Year 1968-1969, April 1971.

It is assumed that participants in the conference are unlikely to have read these studies in detail. For this reason, a summary of each is available (Appendix I) upon request from the Economic Council of Canada. These summaries are not a substitute for the original studies, and it is suggested that anyone concerned with the "nuts and bolts" of cost studies read them.

The paper does not present an examination of cost studies in the U.S., although comments on the state of the art in U.S. faculty workload studies will be made.

Similarly, U.K. cost studies are excluded.*

One basic assumption underlying this study is that during the 1970's, the participants and the processes in education will have changed considerably. Cost analysis, if it is to be of assistance within this new context, will have to cope with the problems of program comparisons between manpower and education activities, and to some extent also, with health and welfare programs. It is expected that the decision-making systems in the broad area of human resources policy formation will gradually come together, and thus, prompt modifications in cost analysis.** This paper will nevertheless focus upon

* See G. Wilson and P. Lewis, Cost Studies in Higher Education, Higher Education Research Unit, London School of Economics and Political Science, Reprint no. 34. Also published in Higher Education Review, Vol. 2, no. 2, Spring 1970, for a review of the subject in the U.K.

** See Canadian Department of Manpower and Immigration and the U.S. Dept. of Labor, Cost-Benefit analysis of Manpower Policies: Proceedings of a North-American Conference, May 14-15, 1969, Industrial Relations Centre, Queen's University, Kingston, and Conference on the Evaluation of the Impact of Manpower Programs, June 15-17, 1971, Ohio State University, for a discussion of these problems. The Economic Council of Canada's Eighth Annual Review presents an eloquent plea for such a vision of analysis in dealing with problems of human resources.

studies which have been prepared in the current post-secondary educational system.

MAJOR PROBLEMS AND SUGGESTIONS FOR CHANGE
AND FURTHER ANALYSIS

This review of a few cost studies in Canada leads me to believe that even cost studies which would abstract from the cultural, social, and emotional activities involved in post-secondary education are still faced with many problems.

The nature of the problems and the modifications called for are very much a function of the internal and external objectives of the cost analyses, e.g., whether they are used for internal budgeting purposes, or for external planning and forecasting purposes. If the purpose is the latter, it would seem that many extensions and modifications are called for.*

One of the major problems plaguing all of these attempts to determine the costs of instruction, research, and other activities which are part and parcel of university life is that of joint inputs and joint outputs. I

* See chapters 3 and 4 of the Economic Council of Canada's Eighth Annual Review, for a discussion of the approaches involved.

refer here more particularly to the difficulty of separating teaching from research. One can see the difficulties involved by recalling the A.U.C.C. and MacDonald study differences in dealing with graduate student thesis and research supervision. We know, for example, that graduate theses involve inputs of the student's time, and that the major output is a paper, or the conclusion of some experiment. The professor's contribution, both quantitative and qualitative is acknowledged to be very difficult to measure. In addition, if the graduate student's paper or experiment forms part of the professor's research interests, we are faced with an intermediate input to the professor's research, hence a joint input problem. Perhaps a part of the answer lies in developing new research policies within universities, which policies might provide for a research professor status and the establishment of more clearly defined research centers as cost centers. However, here again the nature of many research problems calls for interdisciplinary approaches, and makes it difficult to impute research center costs to different budgetary units, should that be desired.

A closely related problem, and one very much

affected by the teaching-research dichotomy is that of faculty and research workload analysis. We have seen that this is one of the major points of difficulty in the A.U.C.C. Study and that much controversy arose around the use of questionnaires and diary methods to help in the allocation of salary costs paid to university professors among research, teaching, community services, etc. It is here that the lack of knowledge of: a) the implications of audio-visual techniques and new pedagogic methods for faculty time inputs, b) the nature of consulting activities of professors (they may complement or simply be a substitute for formal teaching and research), c) the effects of class, faculty and university size on Workloads, makes it presently difficult to arrive at a satisfactory distinction among teaching, research, and other functions in the university.

It is my impression that some future research efforts should also : a) attempt to weight the different components of teaching, research and other activities*, b) distinguish lab from non-lab from field trip activities

* For some purposes it may be preferable to make use of the weighted average number of students per staff contact hour rather than staff/student ratios.

by level, by discipline, by institution, etc., c) utilize group results as against individual results, d) study the allocation of time in all pursuits, whether or not paid for by the university, etc*.

* See W.G. Bowen, "Teaching Schedules and Teaching Loads at Amherst, Columbia, Cornell, Dartmouth, Denison, Harvard, University of Michigan, Princeton, Stanford, Yale, and Vanderbilt", mimeo, 1970. This study computed the course load, supervisory load and an amalgamation of both of these into teaching loads. Course load is the product of the number and mix of courses taught during a year, the average number of weekly course contact hours occasioned by each course, and the number of teaching weeks in a term. One's own undergraduate course was weighted 1, teaching someone else's courses was weighted .67, and teaching one's own graduate course was weighted 1.33. The supervisory load was calculated as the number of undergraduates supervised, plus 1.5 times the number of graduate students. To arrive at teaching loads, it was assumed that the factor 5 might be used to relate the number of undergraduates supervised for one term, to teaching one course contact hour in one's own course for one term, i.e. to supervise the independent work of five undergraduates for one term was taken to be the equivalent of teaching one hour per week in one's own undergraduate course for one term.

See also the Interuniversity Council of Ohio, Faculty Load Study, January 1970 for a review of 92 studies of faculty workloads in higher education. The authors conclude that the use of a credit hour for evaluating an individual's contribution to the work of his university is less appropriate now than it was ten years ago, and that it was clearly inappropriate then. They indicate that in the last ten years, two separate paths of

One thing which is quite striking is that very different questionnaires and diary approaches used to provide data on the faculty workloads yield strikingly similar results on faculty workloads.

research have been taken in the United States on faculty workloads. The first attempts to develop incremental equivalents of non-classroom activities to the credit hour measure. The second approach summarizes the activities of all faculty members in terms of time spent in various types of work. They mention that typically, no attempt is made to relate these studies to the overall goals of the institution. They also mention the fact that such studies isolate predominantly instructional activities and neglect sponsored research and public service projects. In addition, they do not measure faculty effort in terms of knowledge, intensity of application of that knowledge, and time spent in that application. By study and by the presentation of expected profiles of effort in support of the processes of instruction, research, and public service, they develop guidelines net of separately budgeted and funded research and public service. Assuming a minimum week of 40 hours per person on a full-time contract, they provide guidelines that "each state-assisted university expect at least 80% of the effort of its total faculty on an average, or at least 32 hours per week on a full-time equivalent basis, to be devoted to the instructional process of that university, except for those persons who have served separately budgeted and separately funded research or public service processes." They prefer individual service reports to questionnaires or diaries.

With the exception of the S.R.G. study, and to some extent, but in a more restricted way the Segal study, most of the cost studies examined above paid no more than lip-service to the need to introduce opportunity costs into cost analysis, if at all. With the development of planning-programming-budgeting systems, the emphasis, it would seem, will go towards the explicit recognition and computation of costs in what is known to be the opportunity cost category. This suggests that much more use should be made of avoidable opportunity costs, using ex post data, though the subjectivist opportunity cost theories, as discussed by James M. Buchanan, are appealing.*

The S.R.G. study is a very interesting demonstration of the fact that the costs and benefits of post-secondary education, as determined by accounting costs,** are very different from those determined by taking into account opportunity costs. More precisely, it would

* James M. Buchanan, Cost and Choice, Chicago, Markham Publishing Co., 1970.

** It may be seen in Appendix I that use of Ontario formula weights limits the use which can be made of the actual dollar cost estimates presented in the S.R.G. Cost Study.

seem to me that cost studies in post-secondary education should cost all costs as much as possible, whether these be students' time or the costs incurred by students during the educational process for fees, transportation, baby-sitting, and what have you; whether these be the interest costs in funds tied up in inventory, supplies, equipment and other non-capital assets of universities; whether these involve an imputation for municipal taxes (now levied in Ontario and Quebec) and an imputation for the value of services rendered by municipalities; whether these represent income tax collection losses, foregone because of charitable contributions by individuals and corporations to universities; whether or not these involve evaluation of university buildings and equipment at market cost; whether or not these involve complex problems of imputation for the services of religious teachers who might not be paid according to lay professors' scales, etc.

In summary then, it seems to me that much more emphasis should be put into costing opportunity costs, for these rarely give results identical to accounting costs, and since it would seem that choices among alter-

native policies will more regularly make use of such a concept.*

Another significant problem area is that of determining meaningful ratios to apportion overhead costs of different kinds, if that is considered desirable.** The A.U.C.C. study provides a good indication of the difficulties involved in proper apportionment of various types of administrative costs, computer costs, library costs, etc. to different programs. This involves two levels of apportionment problems, namely, the apportionment of overhead cost between budget units on one hand, and the translation from budget categories to whatever program categories are utilized in the cost analysis.***

* See R.W. Judy, "Costs: Theoretical and Methodological Issues", in Canadian Department of Manpower and Immigration and U.S. Department of Labor, Cost-Benefit Analysis of Manpower Policies, Proceedings of a North American Conference, May 14-15, 1969, pp. 20-21, for an interesting discussion of these differences.

** For certain purposes upon which any economist interested in marginal costs could explain, the overhead costs are of little interest to decision-makers.

***Of course, attempts might be made to apportion overhead costs directly to program categories.

Difficulties arise from lack of knowledge on objectives and on the nature of many of these costs, and from the poor accounting bases which exist in the universities. This problem is compounded because of the joint input and output problems involved in the university, as indicated above. Joint appointments between department, interdisciplinary and inter-university research centers and teaching programs, etc. are reasons for developing inter-cost unit transactions accounting methods, in order to properly determine the total accounting and opportunity costs of training a student in different fields.

Another difficult area involving the same inter-cost unit accounting problem is that of physical plant accounting. Assuming that one would have adequate space inventories, with improvements over those being developed and quantified by the Taylor-Lieberfeld and Heldman group, one would still be faced with the difficulty of apportioning plant and equipment maintenance and annual depreciated capital costs to different cost centers. These problems are rendered more difficult because these costs are a function of: a) the utilization rates by different cost centers, b) the age distribution of the

capital stock, c) the location of the buildings and grounds, d) whether or not the equipment is rented or purchased, etc. The inadequate evaluation of plant assets in the public sector and in the universities, and the current practice of not using depreciation accounting except for those properties which are the investment of endowment funds adds to these problems.* It is no significant extension of the opportunity cost concept to recognize that depreciation of plant and equipment in universities should be accepted, if only because some of the alternatives envisaged, such as

* American Council on Education, College and University Business Administration, revised edition, 1968, p. 148. Current practice is that if an institution is to provide for setting aside current fund revenues for the renewal, replacement, and expansion of educational plant assets, the amount of such provisions should be shown in current funds categories. The orthodoxy, however, recognizes that these provisions for renewals and replacements which seem fairly analogous to depreciation, might be made for auxiliary enterprise plants, which in many instances are similar to commercial enterprises. In addition, depreciation accounting is accepted in endowment fund properties to "give reasonable protection to the principal of the funds so invested, and to reflect properly the net income from such investments". (p. 288).

health and welfare expenditures, or training in industry, make expenditures and costs in buildings and equipment of universities avoidable expenditures. It would seem that a proper accounting of costs of the alternative vying for public funds involves total accounting of all the costs involved, whether capital or operating.

It is also known that use of planning-programming-budgeting systems calls for some re-assessment of the distinction between operating and capital costs, which is a very uneasy one in much of the literature.

Another problem which calls for further analysis is that of choosing the appropriate activity units in cost studies. We have seen costs reported by:

- 1) full-time equivalent student,
- 2) by staff contact hour,
- 3) by student contact hour,
- 4) by course,
- 5) by teaching unit,
- 6) by student by course hour,
- 7) by staff member,
- 8) by credit,

- 9) by places available,
- 10) by course registrant,
- 11) by number of students who graduate,
- 12) by degree, etc.

Each of these activity units has its particular characteristics and each has its strengths and weaknesses in cost analyses. For example, the use of graduates may be preferable to the use of enrolments, which involves converting part-time students into full-time students on the basis of some arbitrary load, a problem which is very difficult at the graduate level. However, use of graduates involves knowledge of drop-out and failure rates, an area just recently being explored.

One might be tempted to suggest that the credit be used as the unit in cost analysis. However, if one reflects upon the nature of pedagogic changes occurring in universities, and the fact that formal contact hours within courses or within labs are only one of the components which might give rise to credit - other components being recognition of personal study by students - one is prompted to reflect twice on that measure. In addition, courses of equal pedagogic (credit) value may be quite

different in their cost implications.

At this stage in my analysis of the question, it would seem to me that a better measure would be to use staff contact hours, i.e. the time spent by staff instructing in different courses. This would seem to be of some interest, because doubling the number of students in the course does not necessarily double the instruction costs in that course. If it is found necessary, for pedagogic reasons or space reasons to section the classes into groups, then the staff-contact hours might double, whereas the student-contact hours would remain the same. It would seem that a better basis for distributing costs would be a combination of both student and staff contact hours.

It seems also that much thought should be given to costing on the basis of courses or activities within courses. The A.U.C.C. discussion of costs and cost differentials, among others, indicates the importance of the number and level of courses in the determination of costs. This cost unit is also singled out in the Segal and Committee of President's studies, and it would seem

that there is much to be said for retaining it as the basic unit for cost analysis. If one thinks of the need to simulate the cost of new pedagogic processes, it seems to me that the Segal study makes the point effectively that one will have to have very detailed cost units to make it possible to simulate very different pedagogic procedures. It might be preferable, therefore, to go into some kind of activity unit (FIU) which is more detailed than a course. This would seem to be less of a problem now with the use and prevalence of computers. However, the more microscopic the cost unit, the more macroscopic the imputation problem becomes. It may be however, that variations in activities at such a disaggregate level will make it possible to consider many costs in the fixed category, and hence, of no concern to one making certain types of decisions.

It would also seem that the course as a basic unit is indicated, in that it will become more and more prevalent to find students who are in different years of their educational experiment in any given course. Attempts to classify and determine the costs by years

within level may therefore become more and more difficult as time goes on. One of the problems with this suggestion, however, is of a planning and control nature. It is known that many universities are adverse to involvement of planning and governmental agencies in too much detail of university operations, and this for reasons which I consider perfectly valid. It might be argued that costing on a course basis would make for direct intervention into the course choices by the funding authority. A solution might be to estimate weighted average course (or FIU) costs by program field.

A closely related problem is that of choosing the budgetary unit for the cost study. This has usually been the department given the traditional structures of the university. Faculty costs have also been computed, and with new structures involving modules, it may be that it will be useful to compute costs for program definitions which are neither departments nor faculties, as would seem to be suggested by the increase in cross-departmental registrations.

Another basic area for further research is that

of trying to determine the nature of cost functions. It is prevalent to assume that cost functions are linear and homogeneous, and to stop the analysis with that assumption. It would seem to me that studies should be undertaken to determine whether there are economies of scale in stable program offerings of different universities. It is evident that as a university matures, its program offerings become more diversified, it becomes more graduate student intensive, and hence, its costs per student increase. This however, represents a mixture of static and dynamic factors, a question which I will come to in a few moments. Further studies should therefore be concerned with costs in emerging study and research programs of established universities, and in emerging universities. Such studies might be made on both cross-section and time series bases. Since there is a great tendency for cost analyses to be translated into weights in different formula financing methods, it would seem very important to determine the nature and shape of different cost functions within post-secondary education, so as not to either under-finance or over-finance different institutions, should the cost functions not be linear. Little is known about the costs of new programs utilizing

new plant and equipment, and utilizing new pedagogic methods. Similarly, very little is known about idle capacity costs of such new programs.

All of the studies mentioned above, and more particularly those done by the A.U.C.C. and the Committee of Presidents brought forth the importance of program structures, pedagogic methods, class size and enrolments in determining university costs, but it should be kept in mind that these are cross-section studies, and that a proper explanation of changes of costs in higher education would probably be concerned much more with those factors underlying changes in university costs, and in particular, the remuneration and number of university manpower for some measure of output, for these are the bulk of university costs. In addition, if one is to think of time series analyses of university costs, one should attempt to segregate those costs which are more directly explained by variations in the number of students, from those whose variations are more closely tied to the number of staff, from those which vary with space. It might be of interest to attempt to classify costs into those which are exogenously determined, such as university

professors' salaries, and those which are more affected by endogenous and internally controllable policy variables, such as staff-student ratios, changes in pedagogic procedures, and class sizes, etc.

In addition, any attempt to reconcile and explain cost differentials either at one point in time or over time, should take into consideration the financing methods which have been used to determine grants to universities, for it is well known that some of these financing methods have had as a purpose to expand the system to increase the quality of the output of the system, and hence, to increase its cost.*

I suggest that it would be desirable to develop a cost index to deflate current costs of universities into real costs, and examine the changes in real costs as well as the changes in monetary costs. If one is to attempt to understand cross-section cost differentials, or changes in such differentials, one would also have to

* See G. Wilson and P. Lewis, Cost Studies in Higher Education, op.cit., for discussion along these lines.

take into consideration the historical development of the system, because it is well known that the structure of decision-making systems in different institutions is more or less decentralized, more or less in the process of changing, factors which per se have much explanatory value in understanding differentials. Similarly, staff on hand in a university or college at any one point in time was hired at different points through time, times at which the labour market, hiring policies, promotion policies, etc. were not necessarily the same as they are presently. It would seem therefore that interpretation and correct analysis of changes in cost differentials in post-secondary education should be taken with the historical perspective also.

A basic requirement for useful cost analysis is significant improvement of data bases. Such an operation is underway in Quebec (SIGU)* and in the Atlantic Provinces (MUSIC). This is by no means an easy operation, for it involves the determination of

* Système informatique pour la gestion des universités, Comité de coordination du C.E.S.I.G.U., Ste. Foy, Québec, le 29 avril, 1971.

very precise definitions for different elements which enter into the data banks for staff, students, space, teaching and research programs, etc., and in addition, it involves some coordination of administrative procedures for the collection of data, etc.

Though there has been some improvement in the situation described by the A.U.C.C. Cost Study, it still remains a fact that inter-institutional comparisons of costs are very difficult, given differences in the way in which part-time students are defined, the way university professors are classified, etc. Without an effort to develop adequate data bases, cost analyses will remain very limited in their efficiency.

If the hypothesis made earlier, namely that the formal educational system will become more and more involved in joint teaching and research operations with industry and government is correct, it would seem to me that the data banks should be developed in such a way as to encompass elements of information on details of activities involved in such areas.

A very important area for development is that of simulation models utilizing various endogenous and exogenous policy variables in an attempt to simulate the costs of new pedagogic procedures and of new teaching and research arrangements with industry and/or government. This involves, as Mark Segal has demonstrated, the use of very microscopic cost data elements, but in addition, it involves much analysis of the shape of cost functions.

APPENDIX I

SUMMARY OF:	Page
I. THE UNIVERSITY OF CALGARY COST STUDY	1
II. THE A.U.C.C. COST STUDY	13
III. JOHN B. MacDONALD & AL - LE GOUVERNEMENT FEDERAL ET L'AIDE A LA RECHERCHE DANS LES UNIVERSITES CANADIENNES	42
IV. COMMITTEE OF PRESIDENTS OF UNIVERSITIES OF ONTARIO, STUDY OF ENGINEERING EDUCA- TION IN ONTARIO	48
V. CONFERENCE OF RECTORS AND PRINCIPALS OF QUEBEC UNIVERSITIES COST STUDY	62
VI. SYSTEMS RESEARCH GROUP COST AND BENEFIT STUDY OF POST-SECONDARY EDUCATION	78

APPENDIX I

SUMMARY OF:	Page
I. THE UNIVERSITY OF CALGARY COST STUDY	1
II. THE A.U.C.C. COST STUDY	13
III. JOHN B. MacDONALD & AL - LE GOUVERNEMENT FEDERAL ET L'AIDE A LA RECHERCHE DANS LES UNIVERSITES CANADIENNES	42
IV. COMMITTEE OF PRESIDENTS OF UNIVERSITIES OF ONTARIO, STUDY OF ENGINEERING EDUCA- TION IN ONTARIO	48
V. CONFERENCE OF RECTORS AND PRINCIPALS OF QUEBEC UNIVERSITIES COST STUDY	62
VI. SYSTEMS RESEARCH GROUP COST AND BENEFIT STUDY OF POST-SECONDARY EDUCATION	78

1. THE UNIVERSITY OF CALGARY COST STUDY

The primary objective of this study was to estimate the operating cost of educating winter-day students at the University of Calgary for the academic year 1969-70. This was done in three phases: Phase I - program definition, Phase II - program cost analysis - i.e. the allocation of net operating expenditures to programs, Phase III - program activity analysis, namely analysis of program cost in terms of students. The University of Calgary cost study is patterned on that of the University of Alberta at Edmonton.

The Edmonton cost study identified the following five major program areas:

1. Instruction

- (a) First year undergraduate
- (b) Second year undergraduate
- (c) Third year undergraduate
- (d) Fourth year undergraduate
- (e) Graduate

2. Supervision of Student Research and Thesis Work

- (a) Masters
- (b) Doctoral
- (c) Other

3. Research

4. Administration

- (a) Departmental
- (b) Faculty
- (c) University

5. Student, Public and Community Services.

Departmental participation in these programs was determined either on a department budget unit basis by questionnaire or, given the structure of the University of Edmonton, by judgemental assignment when the department is a "non-faculty and school department". Exceptions are for the library plant maintenance and users' service departments, where usage indicators were apparently available.

Departments were classified into teaching and non-teaching departments. Activities of teaching departments were determined by analysis of the time spent by staff on each of the five major program categories indicated above. Questionnaires on these matters were prepared by department heads for each of eight staff classifications: Professor, associate professor, assistant professor, instructor-lecturer, graduate teaching assistant, other teaching staff (research associate, post-

doctoral fellow, etc.), administrative and professional officer, and non-academic staff.

Program time breakdown was attempted between winter months and summer months. A single indicator of program involvement for each classification of staff for each department was estimated. Time percentage indicated in the winter session column was multiplied by 8/11, and added to the time percentage indicated in the summer column, after multiplying it by 3/11.

The Calgary cost study is quite similar to the Edmonton study, although they distinguished primary from secondary programs. The following is the classification adopted:

I. Primary Programs

1. Instruction

- (a) First year undergraduate
- (b) Second year undergraduate
- (c) Third year undergraduate
- (d) Fourth year undergraduate
- (e) Graduate

2. Supervision of Graduate Student Research and Thesis Work

- (a) Masters
- (b) Doctoral
- (c) Other

3. Research
4. Creative Activity in Art and Scholarship
5. Services to the Public

II. Secondary Programs

1. Administration
 - (a) Departmental
 - (b) Faculty
 - (c) University
2. Services to the Academic Community
 - (a) Academic Support Services
 - (b) Library Services
 - (c) Student Services
 - (d) Agency Services
3. General Support
 - (a) Physical Facilities Maintenance
 - (b) Miscellaneous

Unlike the Edmonton Study, the Calgary Study divides program activities into fourteen classifications: Deans/directors; professor; associate professors; assistant professors; instructors/lecturers; other full-time permanent; faculty on leave; full-time sessional; part-time sessional; graduate teaching assistants; readers, demonstrators, post-doctoral fellows; other academic staff; supervisory/professional; and other support staff.

The second difference is that program parti-

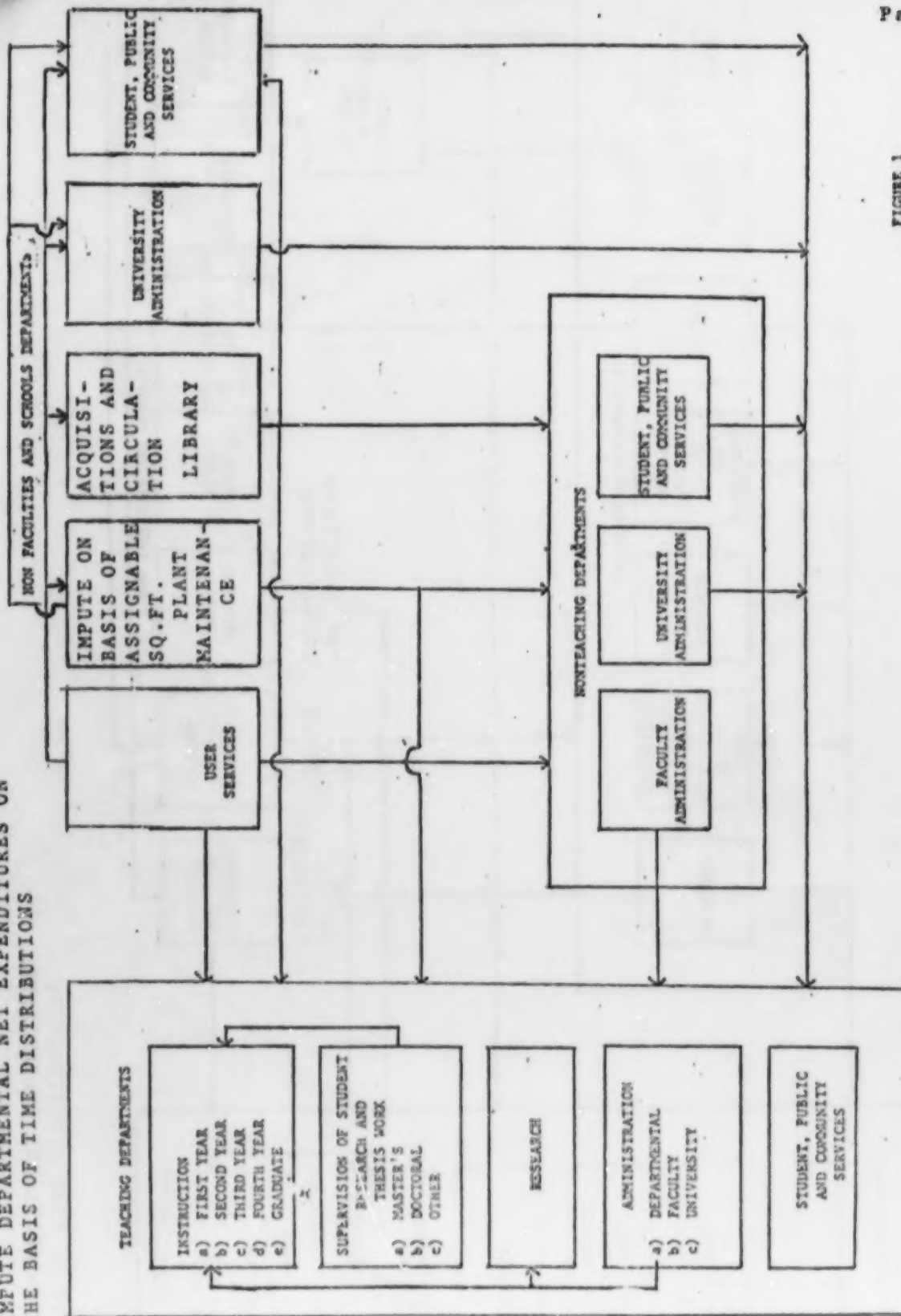
cipation is indicated by one percentage figure to account for all time spent on program activities during the academic year rather than by two figures, one to represent time spent during the winter months and the other to represent time spent during the summer months.

The assignment of net cost procedures are indicated on figure 1 (Edmonton), and on Figure II (Calgary).

The allocation of expenses of plant maintenance is on the basis of assignable square feet. No mention is made of other factors which might enter into the process, such as age of building, campus layout, etc.

The allocation of library expenses on the basis of acquisitions and circulations is of interest. The separation of library expenditures into research and instruction is, however, one difficult problem in this area. It is interesting to note that in the Calgary cost study, the accumulated expenses of library services are allocated to teaching departments on the basis of acquisitions and enrolees taught.

IMPUTE DEPARTMENTAL NET EXPENDITURES ON THE BASIS OF TIME DISTRIBUTIONS



NET EXPENDITURES

FIGURE 1
THE EDMONTON COST STUDY
FLOW DIAGRAM

IMPUTE DEPARTMENTAL NET EXPENDITURE
ON THE BASIS OF TIME DISTRIBUTIONS

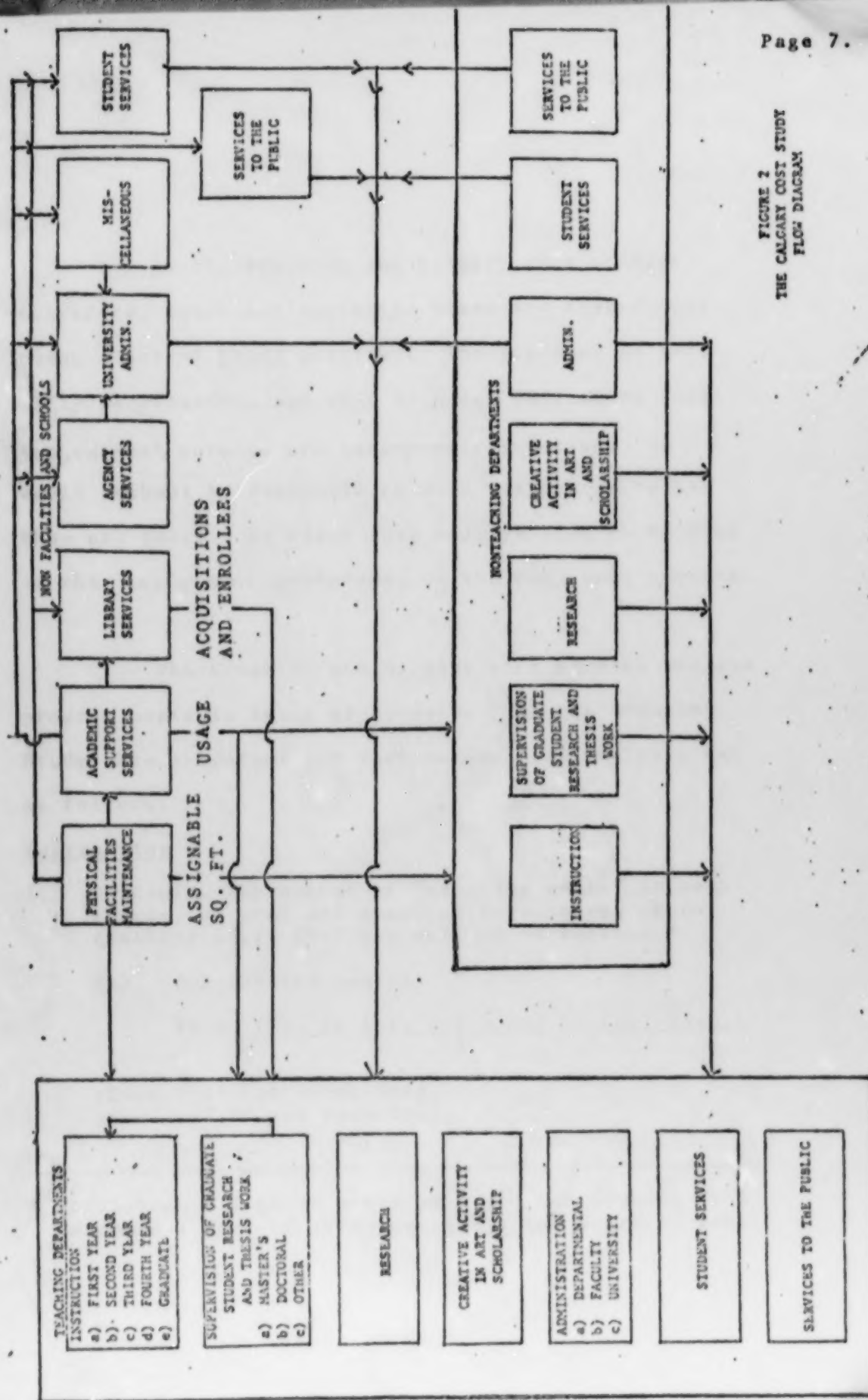


FIGURE 2
THE CALGARY COST STUDY
FLOW DIAGRAM

In the Edmonton and Calgary cost studies, therefore, total net operating costs are distributed among a set of broad programs. The approach is basically descriptive, and when no usage indicators exist, judgemental factors are necessarily involved. It would perhaps be desirable to work with gross rather than net costs. It seems that more remains to be done on the assignment procedures of the many cost sources.

The Edmonton and Calgary cost studies analyze program costs in terms of students. In the Edmonton Study, the procedure for instruction cost analysis was as follows:

Instruction

1. Determine the number of "teaching units" in each course, by year and teaching department, where teaching units (TU) are defined as follows:*

(a) for lecture course:

$$TU = \frac{(\text{No. of Lec. Hrs.} \times \text{No. of Lec. Sect.})}{3}$$

times 1 if two terms long,
times 1/2 if one term long.

* Division of lecture hours by 3 and lab courses by 6 assumes 1 hour of lectures equals two hours of labs.

(b) for laboratory course:

TU (No. of Lab. Hrs. No. of Lab. Sect.)
6

times 1 if two terms long,
times 1/2 if one term long.

(c) for a laboratory/lecture course:

TU (No. of Lec. Hrs. No. of Lec. Sect.)
3

(No. of Lab. Hrs. No. of Lab. Sect.)
6

times 1 if two terms long,
times 1/2 if one term long.

2. Prorate Instruction costs to each course based on the number of teaching units.
3. Divide the cost per course by the enrolment to arrive at a unit cost per course enrollee.
4. Accumulate enrollee costs by year and department of enrollee registration for full-time and part-time students.

In the Calgary cost study, the instruction cost analysis procedure was much simpler and consisted in the following:

1. Accumulate total enrollees taught by year and teaching department,
2. Divide instruction cost by enrollees taught to arrive at instruction cost per enrollee,
3. Accumulate course enrollee costs by program and

department of enrollee registration for full-time and part-time students.

Apparently, cross-registration of students between departments and over years was not a significant problem at Edmonton and Calgary. The growth of inter-disciplinary study programs will complicate the imputation problems involved.

The difficulty in distinguishing between full-time and part-time students is prompting some cost analyses on other bases, such as credits, courses, or hours taught, to avoid this problem.

The allocation of research costs in both of these studies will be commented upon when the time-study analysis is examined.

The authors set forth some of the limitations of their study, namely the fact that differing organizational structures and varying degrees of data availability render the two studies difficult to compare. In addition, they mention that one basic limitation is

that the single most important input to the study is based on a subjective analysis of time distribution of faculty members in various departments. Needless to say, this is a limitation which is fundamental to most cost analyses. It is interesting to note that in these studies, only the part of faculty time which is paid for by the budget unit is accounted for. It is known that many of the consulting and other activities of university professors are either complimentary to, or substitutes for their teaching and research activity. In principle, it would seem desirable to attempt an assessment of time distribution, including all activities, whether or not paid for by the university. In addition, this analysis of time distribution of faculty will undoubtedly be confounded, as new pedagogic methods utilizing audio-visual equipment become more widespread in post-secondary education. Similarly, if one takes a broader view of the training of human resources, it would seem that the studies of time allocation of professors would have to be adapted to situations where much of the training would be on the job and in industry, and many student activities being on location and in the "field".

In summary then, these are descriptive studies, they use net operating costs, they use a restricted number of aggregative programs, and though an attempt is made to use teaching units in the Calgary Study, the reference is to students, which is a very simplified activity measurement.

The study is not well structured for analytical purposes, and there are no formulae explicitly developed to predict changes in costs, as policy elements are changed.

II. THE A.U.C.C. COST STUDY*

"It became clear that Canadian Universities were emerging from the character of semi-private institutions, whose modest stands upon the public purse demanded a minimum of accountability. Finally, the Bladen Report revealed the inadequacy of financial information available about the operation of universities. It was found that the techniques of cost accounting and program analysis, normally undertaken by business enterprises, were not being applied to university record-keeping. It was also discovered that the complexity of university funding with income being received from a multitude of sources and spent in a variety of ways tended to make it difficult to find out what actually was going on."

I shall comment only on the methodology involved in the A.U.C.C. study, in view of the numerous comments casting doubts upon the validity of the data collected, and hence the quantitative results obtained.

The authors of the study indicate that their study is based upon A.J. Carroll's study of United States

* Association of Universities and Colleges of Canada, An Exploratory Cost Analysis of Some Canadian Universities, A Report on the Study of the Costs of University Programs in Canada to the Association of Universities and Colleges of Canada, The Canadian Association of University Business Officers, The Canadian Association of University Teachers, Ottawa, 1970. This was a pilot cost study which reports on results at twenty-three universities for the school year 1966-67.

Medical Schools.* It is unfortunate that the decision was made not to present alternative procedures and to discuss the validity of different methods.

The study begins by classifying the primary functions of universities as being the instruction of students and the conduct of research. It was then agreed that all other university activities, except those usually classified as ancillary enterprises, would be viewed as contributing to the primary functions. It was decided that ancillary enterprises represented separate university functions only peripherally related to instruction and research, and that they should be excluded from the cost of these functions, except to the extent that their operation represents a subsidy from university funds. In addition, among primary activities, the A.U.C.C. study distinguishes student research and thesis work. Operating costs are calculated for instruction, student research and thesis work, research, and ancillary enterprises.

Recognizing that cross registration by department

* A.J. Carroll, Medical College Costs and Manual of Procedures, Evanston, Association of American Medical Colleges, 1965, p. 64.

would create cost allocation problems, the study opts for the faculty as the basic unit of analysis. After regrouping of DBS - CAUBO categories, it reports costs for thirty separate faculties. The authors recognize that faculty-wide averages hide the relative complexity of cost differentials by department.

Cost data was requested for each undergraduate year, and for each graduate level, pre-masters, masters, and doctoral. By assuming that a general B.A. or B.Sc. was invariably awarded at the end of the third year, and relating all of the years to this base, it was possible, to quote the authors, "to resolve in a reasonably consistent manner problems posed by part-time students and special students which could not be assigned any particular year." It is my impression that this problem will grow in significance, as continuing education involves people at different stages in their studies in the same courses.

It was also decided to relate research costs to instructional activity by year and level.

Figure 3 indicates the imputation methods used in the study.

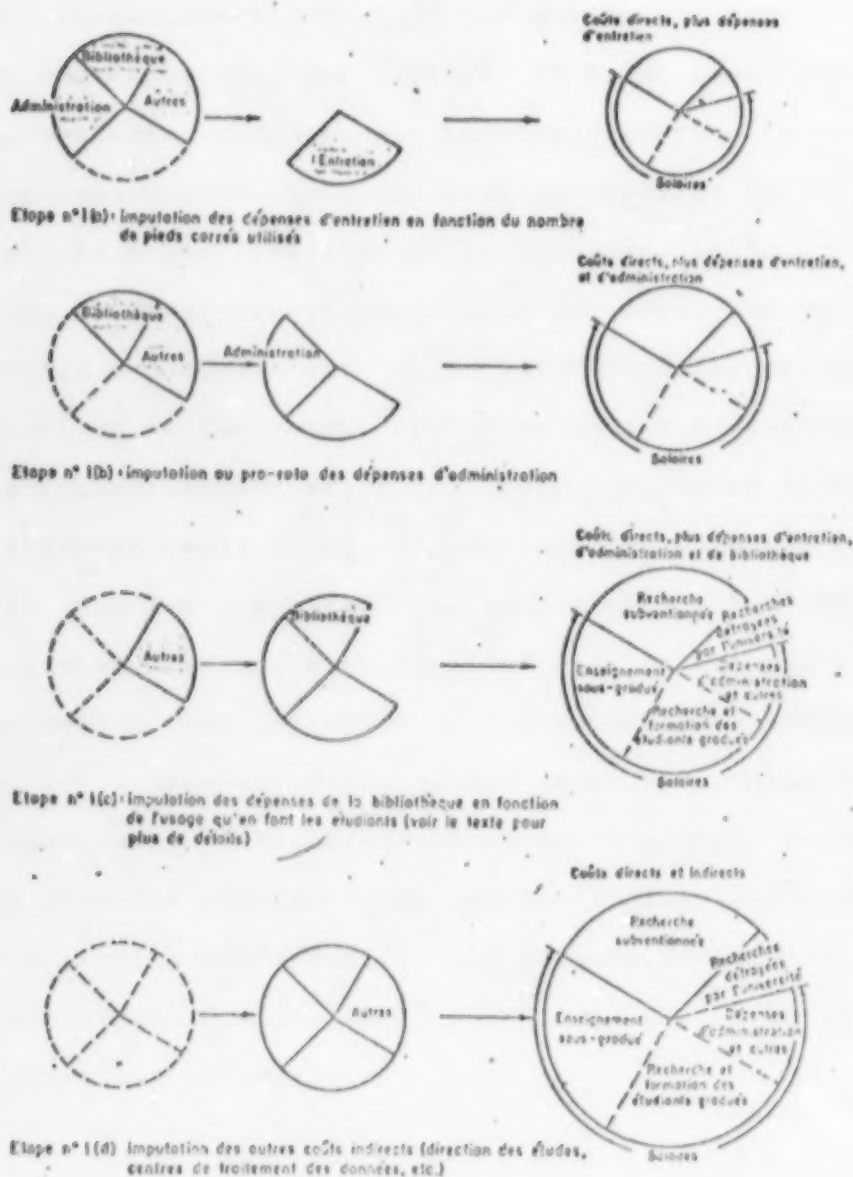
It was decided that ancillary expenditure costs would be allocated in a single total for each institution, and that no attempt would be made to apportion these by year of faculty.

The deficit for ancillary enterprises was divided by the total number of full-time equivalent students enrolled. The authors acknowledge the difficulty in making cost analyses because of the prevalence of joint costs.

The procedure for the execution of the cost study began at a departmental level, with costs attributable to the department. These are referred to as direct costs, though they are not direct in the general sense of being directly related to any particular program, or in the most specialized accounting sense of the term, which involves an idea of direct variability with some measure of activity.

FIGURE 3

Méthode d'imputation des coûts indirects utilisée dans l'étude des coûts effectuée par l'A.U.C.C.



Source : J.B. MacDonald. Op. Cit. p. 161

Figure 4 provides information on the accounting at the departmental level. Columns correspond to different programs with which the department is involved, as well as for those general overhead and subsidiary activities to which the department contributed. A major element of direct cost, academic salaries, was first apportioned to programs in accordance with the distributions reported by the faculty members in a questionnaire to be discussed below. Any portion of other direct expenses which could not be apportioned in accordance with their nature and purpose were distributed to the various programs in the same proportions as aggregate faculty salaries. That portion of direct departmental costs which had been allocated to non-departmental functions, such as faculty administration, university administration, etc. was then transferred out of the departmental cost and added to the appropriate overhead items for subsequent distribution as part of those items. Overhead costs were classified as non-academic, a category which included institutional administration (subdivided into general administration, and student administration, library, other institutional facilities and services, and ancillary enterprises).

FIGURE 4

DEPARTMENTAL SUMMARY - FACULTY OF ARTS AND SCIENCE - DI

Name	Total Payment							
		1. Instruction 1st Year	1. Instruction 2nd Year	1. Instruction 3rd Year	1. Instruction 4th Year	1. Instruction Master's	1. Instruction Doctoral	
1. Professor Jones (Form II)								
2. Professor								
3. Associate Professor								
4. Assistant Professor								
5. Lecturer								
6. Assistant Academic Staff								
7. Non-Academic Staff								
8. Sub-Total Salaries								
9. Equipment								
10. Other Direct Expenses								
11. Group Benefits								
12. Assisted Research								
13. Salaries								
14. Equipment								
15. Other Costs								
16. Group Benefits								
17. Sub-Total Assisted Research								
18. Total Direct Expenses								
19. Transfer to Overhead								
20. Cost Centers								
21. Total								
22. Indirect Expenses								
23. Plant Maintenance								
24. Student Administration								
25. Library								
26. Faculty Overhead Costs								
27. Departmental Overhead Costs and General Reading and Study								
28. Sub-Total Indirect Expenses								
29. Total Direct and Indirect Expenses								

1. Instruction 3rd Year
1. Instruction 4th Year
1. Instruction Master's
1. Instruction Doctoral
2. Student Research & Thesis Work Master's
2. Student Research & Thesis Work Doctoral
3. Research
4. General Reading and Study
5. Non-Academic Student Services
6a. Departmental Administration
6b. Faculty Administration
6c. University Administration
7. Inter-University and Outside Acad. Organizations
8. Public and Community Services
2. Student Research- & Thesis Work Master's Students
2. Student Research & Thesis Work Doctoral Students

Costs relating to the faculty deans and their offices, and salaries of any university deans or academic vice-presidents and their staff were also placed in a non-departmental expense category.

The total of each overhead category was then allocated to other overhead categories or to the faculties or departments to which they seem to relate. This was carried on until all costs, except ancillary enterprises and other services, had been distributed directly or indirectly to the teaching departments (the step-down method). Within each department, each overhead cost category was then distributed among the programs for which the department was responsible. This produced for each department a total figure which represented all direct and indirect costs reasonably attributable to the department. Costs by program were summarized to obtain the total cost of each of the programs carried on by faculty and at the total university level.

It was decided to use a student (full-time students) as a measure of activity. Since students often register across faculties, the cost of the faculty offerings related to the number of students registered by courses

permitted calculations of course costs per course registrant. Since each student registers for five or more courses, the unit costs per course registrant are correspondingly lower than the average cost per student. Since variations in class size are of importance, it was also decided to calculate the cost per course. Some crossover tabulations were prepared to account for the cross-registration and multiple year registrations. These calculations were made separately for each of the primary programs: instruction, student research and thesis work, and research.

The handling of research costs constituted a difficult problem in the A.U.C.C. Study. It was decided to try to determine the portion of each faculty member's time devoted to research. An attempt was made to distinguish research from general reading and study, and from student research and thesis work. Research costs were treated as a separate program throughout the study. Costs directly attributable to research were accumulated under that heading, and a reasonable proportion of the overhead costs were allocated to the research category to produce for each department the total for the cost of research

carried on. These were summarized to the faculty and total university level.

Recognizing the relationship between research and instruction, it was decided to provide an alternative calculation, in which research costs would be related in some way to instructional costs. The committee assumed that the costs covered by assisted research grants represented pure research costs, and that the balance financed by the university would be treated as a cost of instruction. It is acknowledged that this is not a satisfactory solution. The first stage in the calculation of the unit cost of research was, therefore, the elimination of the assisted research expenditures. This net figure for each department was then distributed to the years or levels of instruction for which the department was responsible. These were distributed by allocating half the cost in proportion to the faculty time distribution, and half in proportion to student enrolment in the courses offered by the department.

Both these methods of calculation imply that research benefits the staff and students, and that the

costs of research are a cost of instruction. The first method, however, apportions the cost by classes, regardless of the size of the classes, whereas the second method, based on student numbers, apportions a share of research costs to all students equally, regardless of the size of the classes which they attend. The authors go on to indicate:

"It seems obvious in retrospect that this basis of allocation was unrealistic, and that it has probably understated the portion of research costs attributable to graduate instruction in two ways; first, by treating graduate students as entirely equal to undergraduate students, and second, by failing to recognize that the graduate students, on the whole, take fewer courses than undergraduates, and that they are therefore disproportionately underrepresented in the calculation. A further distortion arises from the fact that no portion of the general research costs was directly allocated to student research and thesis work, although an amount of research costs proportionate to the faculty salaries allocated to student research and thesis work is included in the amounts allocated to graduate programs in the salary-based portion of the calculations. This omission was originally justified on the grounds that any research costs directly related to student research and thesis work would be costed separately as part of that programme, so that the amount remaining in the research total would be the amount not directly related to student research work, and thus the amount to be related to ordinary instruction. It was found that in research,

however, that faculty members were not readily able to analyse their research efforts in this way ... it follows that the research elements in the costs determined for the students have as a result been understated." (p. 13)

1. The Faculty Questionnaire

An estimate of faculty workloads was undertaken by questionnaire. Only time devoted to university affairs, and for which university salaries were paid was taken into account. Percentages of remunerated time were asked, rather than actual hours. The questionnaire asked for the apportioning of time among the following categories:

- 1) Instruction - subdivided into courses by year/level,
- 2) supervision of student research and thesis work - subdivided by level,
- 3) research,
- 4) general reading and study,
- 5) non-academic student services,
- 6) administration - subdivided into departmental, faculty, and university,
- 7) inter-university and outside academic organizations,
- 8) public and community service,
- 9) other programs.

11. Overheads

The major categories used were plant maintenance, institutional administration, and library.

a) Plant Maintenance

It was assumed that plant maintenance tends to be a largely self-contained operation, which does not account for a very significant portion of the time or effort of central administrative officials. The guidelines recommended that the apportioning of plant maintenance be the first stage in the analysis, and that calculations proceed progressively from that point, ignoring any reverse re-apportionments which might theoretically be desirable. It was suggested that plant maintenance costs be allocated in the first instance to individual buildings, and that costs which could not be apportioned on a factual basis be allocated in proportion to the gross floor area. Costs of each building were then to be apportioned in proportion to the amount of usable floor space devoted to different categories of space. The latter criterion was suggested as the best alternative, if allocation to indi-

vidual buildings on a factual basis was impossible. The authors recognize that such a measure would understate the cost of buildings used intensively by high numbers of students, and similarly, would fail to differentiate between the costs of occupying old, spacious buildings and modern, more compact and economic buildings. It was recommended that the cost of each facility or group of facilities should be apportioned either directly to programs, or to faculties, academic departments, or administrative divisions actually using them.

b) Institutional Administration

The authors recommended that institutional administration be divided into two categories, namely

- a) general administration, which consists of both general and business administration expenses, and which was to be allocated in proportion to total direct expenses on goods and services as well as salaries, and
- b) student administration, which was to be allocated in proportion to student enrolments. A more complex system was developed, but it was not suggested that it be used.*

* see pp. 20-21 of the A.U.C.C. Study.

c) Library

After recognizing that the use of some depreciation technique would be necessary for appropriate library costing, the guidelines suggested that the problem of supplying special collections for research purposes during the year of study be treated as a special non-recurring item and omitted from the costs subject to analysis in the study period. The effect of this assumption is to understate library costs. The remaining direct library expenditures were then to be divided into three major categories: a) book and periodical acquisitions costs, b) processing costs, and c) other costs. The library share of plant and maintenance in general administration expenses were in effect a fourth category of costs to be allocated by a separate formula.

It was suggested that the book acquisitions costs be allocated in light of an analysis to determine the faculty for which the acquired items were purchased.

Processing costs were then to be distributed

to faculties in similar proportions, either as a simple overhead percentage, or if it seemed reasonable, in proportion to either the number of titles processed or some other measure of physical activity. The other costs would be by and large circulation and reading room operations, and it was suggested that if at all possible, these costs should be allocated to faculties in proportion to the use made of them by students and staff members. The sample survey review prepared by the Downs Study of Canadian College and University Libraries* was also suggested as a reference. It was suggested that the distribution of the library's share of general overhead be done in proportion to the sum of the previous two methods, i.e. the proportion which the total of acquisition and circulation costs apportioned to that faculty bore the total of all such costs.

It was also recognized that many institutions would not have sufficient data to make use of this method.

* R.B. Downs, Resources of Canadian Academic and Research Libraries, Ottawa, Association of Universities and Colleges of Canada, 1967.

It was therefore suggested that the alternative basis would be to allocate library costs 50% on the basis of students enrolled by faculty, and another 50% on teaching staff in the faculty. The apportionment of the faculty share to departments was done on the basis of the 50-50 formula. Such costs were to be apportioned to programs, including general study and research, in proportion to the faculty salaries allocated to these programs.

d) Faculty and Departmental Overheads

The guidelines provided that those costs which had been accumulated at the faculty level were to be allocated to the departments within the faculty on a formula which involved allocating 50% of the cost in proportion to the number of full-time staff members of the rank of lecturer and above, and 50% in proportion to the number of students enrolled in courses. Full-time equivalents were used for professors. No such adjustment was needed for students, for the number of course registrants was utilized. Following these procedures, departments show costs for the following programs:

- 1) Instruction by year/level,
- 2) student research and thesis work by level,
- 3) research,
- 4) general reading and study,
- 5) departmental administration.

Guidelines then provided that a) departmental administration, including at this point the portion of plant maintenance that was not shifted direct to other programs, b) the departmental share of faculty overhead and c) general reading and study be distributed to each program according to the portion which total salaries, (academic, non-academic, and assistant research) allocated to each instructional programme, bear to the total cost of such salaries.

iii. Unit Costs

The first stage in the unit cost calculation was the preparation of a course enrolment analysis form showing the origin of the students taking courses at each level in the department, and permitting the distribution of the costs of offering instruction at that year or level to the years and faculties in which the students were actually enrolled. The authors recognize that the

courses are not of equal weight and have registrants who should perhaps not been given equal weight in these calculations. That courses be of unequal weight seems plausible, but it seems to me, that for cost purposes, a student is a student in any given course.

The total of assisted research grants was deducted from the gross total and the remaining net research costs were then distributed among the various years or levels by a formula which was based on 50% of the salary distribution of the academic teaching staff, and 50% on the basis of student registrations in the various courses. The supervision of student research and thesis work was assumed not to involve the transfer of costs from one faculty to another.

It was assumed that part-time students would not as a rule be enrolled in particular years, and that they should be treated as a separate program. It is therefore not considered necessary to discuss the problems involved in converting part-time students to full-time students. At the graduate level, however, it was suggested that some standard student course load should be determined and those students taking a different number of courses be converted into an appropriate fraction of a full-time student.

Recognizing that the work load of students engaging in graduate work might vary between thesis work and course work, it was suggested that it might be necessary to adjust the actual numbers reported, in order to arrive at an equivalent thesis student on which unit cost should be based. No instructions were given, however, on this matter.

No suggestion was made for the conversion of part-time students into full-time students. This is a definite limitation of the analysis, for it is well known that the conversion of part-time into full-time students is variable from institution to institution. In recognition of the influence of class size on unit cost per student, it was decided that an attempt should be made to calculate the cost per class or course. Since some classes are combined and others divided into sections, a "teaching unit" was adopted to describe the basic unit that was intended. It was decided to treat courses in which students are given lectures and then divided into lab sections or tutorial groups as a single "teaching unit".*

* See p. 9 above for the Calgary approach, which takes sections into consideration.

The participating institutions were asked to submit a summary of the university's total expenditures, details of the expenditures of each of the departments and faculties as calculated in the study, a summary of research costs in each department, and their allocation to year/level, a summary of the net cost of student research and thesis work by departments and faculty, and an analysis of the students taking courses in each department by year/level and faculty. Institutions were asked to complete a questionnaire explaining their treatment of various optional items, and asked to submit other information which would assist in interpretation of the results obtained. The institutions were not required to submit any details of their calculations of the crossovers. Nor were they asked for details of the allocations on various overhead expenditures, such as plant maintenance, general administration and library.

iv. Evaluation of the Method

It is a well known fact that university data bases leave much to be desired for a variety of reasons, i.e. the data elements on students, staff, space, programs,

courses, etc. are far from standardized from institution to institution and sometimes within an institution; the dates of data collection are different, given different administrative procedures; most accounting systems were established for budgeting and control purposes, making it difficult to relate expenditures to programs, etc. It is unfortunate that the guidelines suggested definitions and in some instances methods of imputation, but did not ask each institution to provide details of their calculations, for information on these matters would certainly have been of much assistance for future cost studies.

It would seem that insufficient attention was paid to the trimester as against semester operation, and to the fact that the length of the period for which full-time staff are hired is variable.

A particular problem acknowledged by the authors of this study is differentials in post-secondary educational structures. The scheme used by the authors (see p. 19) certainly produces limited results for the years classified as preliminary.

The most contentious problem raised and discussed in the A.U.C.C. Study is the faculty workload approach. It is interesting to note that two validity studies were undertaken, one in 1967-68, which was unsuccessful because of administrative problems in obtaining questionnaires from a suitable sample of academics, and another in 1968-69. These validity studies were intended to provide an evaluation of the accuracy of the questionnaire method of apportioning faculty time (and thus of allocating salaries and salary-rated costs). As is indicated in the A.U.C.C. Study, the validity studies were not of direct usefulness in determining whether the questionnaire results were adequate, for a variety of reasons which are very well discussed. The discussion indicates the poor state of knowledge in this area of faculty workload study, a problem which we shall return to below. It does, however, point to some interesting methods and approaches, which are presently being examined in the faculty workload methodology study being prepared by the Conference of Rectors and Principals. It does point out that group results may be of importance, especially if they are provided by rank, field of study, size of institution, and nature and extent of administrative responsibility.

It is interesting to note, however, that in the overall results, the group time distributions obtained by the questionnaire method, and those obtained by the diary method were fairly similar.

Another point made by this discussion is that the separation of faculty time between own major research and the supervision of student research and thesis work is a very difficult one. In addition, it was found that professors have difficulty in distinguishing between those public and community services which they undertook in their private capacity as citizens, and those which they undertook as representatives of the university. One implication is that perhaps too much detail was asked for, given the method of data collection (questionnaire and/or diary).

Joint appointments also create difficulties which should be coped with in very specific terms.

Current treatment of the indirect benefits of student research and thesis direction and indirect costs of assisted research programs is very inadequate, as we

shall see when we discuss the MacDonald Study in the next section of this study.

It was not found possible to devise a practicable scheme for the recognition and apportionment of the research element in library costs. No institutions were in a position to make allocation of library costs by years/levels on a factual basis. Since several library costs, such as research and general reading and study have no students associated with them, it was not possible to bring student numbers into the allocation formula, and library costs had to be distributed within each department in proportion to faculty salaries alone. It would seem that much remains to be done in the data base required for adequate library costing. Similarly, the treatment of library costs as current and operating costs, rather than as capital costs to be depreciated each year, raises questions which will certainly have to be pondered further. Another limitation readily acknowledged by the authors of the study is that the equal weighting of graduate and undergraduate students was probably unjustified in the allocation of many costs, and especially research costs.

Unlike the Calgary and Edmonton Cost Studies, variations in course lengths were not explicitly introduced into the original instructions for the A.U.C.C. Study, and consequently, many institutions did not weight courses or students in the process. One problem in weighting courses is that for pedagogic purposes, the same course is given different weights, depending upon the program or faculty in which it is provided.

The authors make the suggestion that in future studies, the basic unit should be recognized as the full-student load, defined as the number of courses and/or lectures, labs, etc. taken by full-time students in one academic year. They recognize that this unit varies from program to program, and that weighting might be needed. They suggest that courses which represent $1/10$ of the student load be counted at .1, and those which represent $1/5$ be counted as .2, the basic principle being that a full student load is equivalent regardless of program, in that courses are to be equated in accordance with the weight they carry in determining overall standing. I submit that this approach is not useful, for courses of varying pedagogic weights may still cost

the same per student, especially if students from different programs are all involved simultaneously in the same course.

The authors willingly acknowledge the difficulties in weighting students and converting students with different status at the graduate level into full-time equivalent graduate students. They conclude that for a variety of reasons, the number of graduate students to whom the instruction and thesis supervision were offered has been overstated, and the unit cost per student correspondingly understated in their study.

The A.U.C.C. Study also omits recognition of the costs of providing the physical facilities used in universities. This is acknowledged to be a serious omission, as is the omission of interest cost properly imputed to funds tied up in fixed plants, supplies, equipment, and non-capital assets.

The study demonstrates the importance of variations in class size in determining variations in unit costs. This is a result which parallels some of the results

obtained in the Committee of Presidents' analysis.

It would also seem that the tremendous difficulties faced in determining graduate student costs pose problems analogous to those in the professor workload studies. Perhaps similar approaches will be necessary to deal adequately with this problem. The authors also point to the number of subjects offered in different programs as an important factor in explaining variations in costs.

In summary, it can be concluded that the A.U.C.C. Study is one of the most significant attempts to estimate costs in universities. It is acknowledged that its success in dealing with faculty workload analysis was very limited, and this remains as a basic problem in most of the available studies. In addition, in retrospect it would seem that the A.U.C.C. Study should have a) attempted to define data elements very precisely, b) suggested imputation and cost apportioning methods to be used in all instances (even though this would certainly have made for less detailed analysis), and c) ascertained the application of these concepts and methods

in each institution.

The study, a descriptive one, did not develop any methods for cost simulation, a very important area for further studies. The authors are to be commended for their analysis and discussion of many very complex cost apportioning methods, for these have certainly paved the way for more efficient analyses in the future.

In retrospect, it seems obvious that the basic reason for the many difficulties encountered in this study is the fact that the accounting systems available in the universities were, and to some extent still are, oriented toward budgeting and in control for internal purposes. It is not surprising that it proved difficult to relate expenditures to purposes, a task difficult even if universities had similar accounting systems.

III. JOHN B. MacDONALD & AL - LE GOUVERNEMENT FEDERAL
ET L'AIDE A LA RECHERCHE DANS LES UNIVERSITES
CANADIENNES*

"L'estimation des coûts indirects que l'on pourrait raisonnablement imputer à la recherche subventionnée dépasse les possibilités des études de coûts entreprises par les universités et n'est pas réalisable à cause des pratiques comptables en vigueur à l'heure actuelle."

L'étude MacDonald nous intéresse car elle aborde certains problèmes impliqués dans l'estimation des coûts indirects de la recherche.

Avant de décrire précisément la méthodologie de l'étude MacDonald, voyons quelques hypothèses particulières utilisées.

D'abord il est intéressant de noter que contrairement à l'étude de l'A.U.C.C., MacDonald ne croit pas opportun de séparer la surveillance des travaux des étudiants gradués de la recherche des professeurs.

* Etude réalisée pour le Conseil des Sciences du Canada et le Conseil des Arts - Etude spéciale no. 7 - Imprimeur de la Reine, 1969.

Il les a donc fusionnés, ce qui donne une estimation qu'environ 29% du temps des professeurs est passé à titre de surveillance de travaux et de recherche.

MacDonald allègue que la directive utilisée par l'A.U.C.C. pour guider les universités dans leur étude de répartition du temps des professeurs a fait que la plus grande partie du temps consacré conjointement à la surveillance des travaux et à la recherche fut attribué à cette dernière.*

Dans sa tentative d'estimer le coût de la recherche en milieu universitaire, MacDonald y attribue 70% du coût des achats de volumes, documents, etc. des bibliothèques.

* Le questionnaire utilisé par l'A.U.C.C. contenant la directive suivante:

"Il est reconnu que l'on peut parfois éprouver des difficultés lorsqu'il s'agit de déterminer à laquelle des catégories il faut rattacher la direction des travaux de recherche d'un étudiant gradué: Doit-on la rattacher à la catégorie des travaux de recherche ou à celle dite de surveillance des travaux relatifs à une thèse? Lorsque les travaux de recherche de l'étudiant gradué contribuent au programme de recherche du professeur, on peut rattacher la majeure partie des travaux de surveillance au programme de recherche.

Il attribue 2/3 des dépenses des centres de calcul à la recherche, un autre domaine ou les algorithmes pour l'imputation de coûts laissent beaucoup à désirer.

Selon son estimation, les coûts indirects de la recherche représentent environ 35% des coûts directs de la recherche. Les dépenses indirectes prennent le service d'entretien, l'administration générale, la dépense d'opération des bibliothèques, les achats d'équipement et d'ameublement de bureaux, et les dépenses d'opération des bureaux de doyens. Il a distribué les coûts indirects de façon uniforme parmi les diverses catégories des coûts directs. Seuls des coûts indirects imputables à l'enseignement au niveau gradué ont fait l'objet d'une estimation indépendante. L'estimation MacDonald des coûts indirects de recherche est de beaucoup inférieure au chiffre tiré de l'étude de l'A.U.C.C. Celle-ci, en effet, en arrive à une estimation de 47% alors que MacDonald en arrive à 35%. La différence est due à la méthode d'estimation des coûts indirects.

Passons à un examen précis de la méthode d'es-

timination des coûts indirects de la recherche telle qu'effectuée par MacDonald. Il définit d'abord les éléments qui composent les coûts directs (par exemple, les traitements des professeurs, les sommes dépensées grâce à des subventions de recherche, les fonds de l'université destinés à la recherche) et ceux qui composent les coûts indirects (par exemple, l'entretien des installations de recherche, l'administration générale de l'université, etc...). Il avoue que cette répartition est assez arbitraire. MacDonald traite la direction des études comme un coût direct, car il ne s'intéresse qu'au coût de la recherche. Selon lui, la direction des études n'ajoute pas au coût indirect de la recherche, et elle doit supporter sa part de l'entretien des installations, de l'administration, et de certains autres éléments des coûts indirects.

S'il s'était intéressé au coût de l'enseignement, il aurait considéré l'administration des études comme un élément de coût indirect. Par contre, il estime que l'achat d'équipement et de fournitures constitue un coût indirect; on sait que dans l'étude de l'A.U.C.C. on a considéré cet élément de coût comme un coût direct. MacDonald indique que s'il s'était intéressé au coût

indirect de l'enseignement, il serait arrivé à un pourcentage différent, car il aurait dressé autrement la nomenclature des dépenses. Même le pourcentage des traitements des professeurs imputables à la recherche aurait été différent. Il ajoute que s'il s'était attaché aux salaires il aurait dressé la nomenclature des dépenses de la même façon, et aurait obtenu le même 35% au terme d'une première étape d'imputation.

En analysant les salaires, il aurait pu aborder une deuxième étape en imputant les salaires des cadres et des services administratifs à l'enseignement et à la recherche, ce qui aurait doublé le chiffre de 35% qui se rapporte aux salaires. Combinant 70% des salaires et 35% des subventions, il serait arrivé à une estimation des coûts indirects qui serait située à mi-chemin entre les deux extrêmes soit environ 50%, résultat qui concorde avec les 47% que l'on retrouve dans l'étude de l'A.U.C.C. Cependant, MacDonald estime qu'il n'est pas nécessaire de procéder à la seconde étape de l'analyse pour en arriver aux coûts indirects imputables aux subventions de recherche. Selon lui, les salaires versés au personnel non-académique ne

semblent pas être affectés par la présence de subventions de recherche, car ces salaires représentent à peu près la même proportion des budgets des salaires des facultés qui disposent de subventions de recherche, que de celles qui n'en ont pas.

IV - COMMITTEE OF PRESIDENTS OF UNIVERSITIES OF
ONTARIO, STUDY OF ENGINEERING EDUCATION IN
ONTARIO*

The purpose of the study was to establish the annual cost per student for each engineering student for the year 1969-70.** The study covers all ordinary operating costs, including engineering department and faculty budgets and all university overhead accounts, including library, administration, and plant maintenance.

The basis for distributing costs was staff-contact hours. Unit costs were developed as the product of two factors: cost per staff-contact hour, and staff-contact hours per student.***

* Committee of Presidents of Universities of Ontario, (now called the Council of Ontario Universities), Ring of Iron, December 1970, and I.W.M. Thompson and P.A. Lapp, A Method for Developing Unit Costs in Educational Programs, C.P.U.O. Report no. 70-3, December 1970.

** Degree costs were also estimated using a crude attrition model.

*** A class of one hundred students receiving instruction for two hours per week generates two staff-contact hours and two hundred student-hours per week.

All service teaching performed outside engineering for programs within the faculty or school were grouped into a single classification. Those not related to engineering programs were also considered as a separate classification.

Staff-contact hours for lecture, laboratory and tutorial components of each class were computed by multiplying the annual staff-contact hours per section by the number of sections required for each component.* They were then pro-rated among students in each year of each program. The result was a staff-contact hour matrix: Each vertical column corresponding to a department, the horizontal rows containing by year and program the number of staff-contact hours provided by each department and the group of outside faculties. One matrix was prepared for undergraduate engineering programs, and one for class instruction in graduate programs. A distinction

* It should be noted that this resembles the teaching unit calculations performed in the Calgary analysis and by Mark Segal. The A.U.C.C. analysis, however, treated courses in which students are given lectures and then divided into lab sections or tutorial groups as a single "teaching unit". It seems to me that the first approach is preferable.

was made between different levels in the graduate sector.

Cost per Staff-Contact Hour

The first step was to divide each department or faculty budget between formal instruction, represented by staff-contact hours, and informal instruction, represented by graduate supervision. This was done by a technique adapted from the Committee of Vice-Chancellors and Principals in the U.K. Under the modified scheme, an implicit relationship was assumed between the cost of one staff-contact hour and the supervision of one graduate student (excluding formal classroom instruction). For the purposes of thesis, supervision and research, each graduate student was identified with a particular department. Undergraduate programs were not associated with one particular department, because of cross-departmental teaching. It was assumed that each graduate student required a fixed number (K) of hours of annual supervision, excluding formal instruction. Thus, the total teaching load of any one department could be expressed as the sum of its annual staff-contact hours plus the product of the K factor and the number of gra-

duate students supervised in that department. This sum is referred to as the number of "teaching equivalents".* To find the value of K for Ontario engineering schools, a linear regression was established between teaching equivalents and the teaching salary components of the budget for each of the thirty-seven departments involved in this study. These components were established by analyzing responses to a question on the approximate time distribution of faculty members. It was assumed, after analysis of available data, that an average of 70% of the faculty members were currently devoted to teaching and supervision, with the balance being spent on administrative duties (15%), consulting (10%), professional and public service (5%). Therefore, 70% of academic salaries was used in the K value determination.

The best linear regression for the 37 points yielded a correlation coefficient of 0.98, and a final

* $E_i = S_i + K (G_i)$ where E_i = teaching equivalents in department i, S_i = staff-contact hours, G_i = the number of graduates supervised by department i.

K value equal to 150 staff hours per graduate student.* This corresponds to a weekly average of three hours per student for a 50 week year. This value of K was used to divide each department's total budget between formal instruction and graduate supervision in the same proportion as its contribution to the total departmental teaching equivalent. The cost per staff-contact hour was set equal to the portion of the total departmental budget devoted to formal instruction (including the department's share of faculty office costs, pro-rated among all departments within engineering, divided by the total staff contact-hours taught by the departments to all students).

It was necessary to develop the cost per staff-contact hour for classes taught by other faculties. This cost was assumed to be equal to the overall cost per staff-contact hour for engineering (the total instruction cost of all departments within engineering divided by the total number of staff-contact hours taught by these departments) multiplied by the quotient obtained by dividing the student

* See W. Thompson and P.A. Lapp for a detailed discussion of some of the problems involved in this approach.

staff ratio for engineering by the ratio for the whole university. This yields a tabulation of instruction cost per staff-contact hour for each department within engineering, and for outside faculties in each of the universities.

It is interesting to note that use is made of a group analysis of faculty time distribution. This is in accordance with one of the possible conclusions to be drawn from the A.U.C.C. Cost Study examined earlier. Needless to say, pedagogy being quite variable between different departments, any university-wide cost would call for values of K which would vary according to the disciplines, as would the approximate time distribution of faculty members.

The cost per staff-contact hour multiplied by the staff-contact hour matrix yields unit costs excluding university overhead. For undergraduate programs, every element of the staff-contact hour matrix is multiplied by the appropriate departmental instruction cost per staff-contact hour. Unit costs were computed by adding the costs along each horizontal row and dividing the

results by the corresponding number of full-time equivalent students in each program and year. The same procedure was followed for graduate programs that generate the instruction portion of unit cost, to which must be added the graduate supervision cost, divided by the corresponding number of full-time equivalent graduate students. This sum yields unit costs for each graduate program in each university, excluding research grants.

A computation of research grants for 1969-70 (designated assisted research) was provided on a departmental basis, and this divided by the appropriate number of graduate students and added to the above cost per graduate student, yields the unit cost, including assisted research.* The percentage utilized to apply university overhead to arrive at total unit costs were derived from the D.U.A. - 4 forms.

It is interesting to note that the calculated percentage of the departmental budget going to graduate

* In many faculties and departments, research grants originate from many sources, rendering very difficult the type of data compilation prepared here.

supervision resulting from the K value determination and the 70% assumption concerning time distribution of staff time is slightly higher, by approximately 8%, than university estimates.

University overheads included costs of libraries, student services, scholarships, bursaries, administration, plant maintenance, general expenditures, and net deficit on ancillary enterprises, all expressed as a percentage of the unit cost derived from academic costs and research grants.*

Undergraduate thesis-contact hours were not reported by all universities. Consequently, it was decided to omit these hours from the undergraduate-contact hour matrix, so that undergraduate thesis costs were distributed evenly over all teaching equivalents in engineering. This produces a relative understatement of fourth-year costs.

* Expenditures for the President's office and the administration of the School of Graduate Studies were not taken into consideration. There is thus a slight understatement of costs.

An interesting characteristic of this study is its attempt to develop an analytical tool for planning engineering study programs. The authors distinguish eight policy variables (some of them interdependent), which could be controlled within a limited range. They are the following:

- 1) Departmental budget per full-time equivalent staff member, i.e. the department's salary load,
- 2) Total departmental-contact hours per full-time equivalent staff member, i.e. the departmental instruction work load,
- 3) The departmental instruction factor, i.e. the total departmental staff-contact hours divided by total departmental teaching equivalents. We have seen earlier that total departmental teaching equivalents are equal to total departmental-contact hours, plus K , times the number of graduate students assigned to the department,
- 4) Faculty student load, i.e. the yearly hours devoted by students in any program to classes taught within the faculty,
- 5) Faculty average class size, i.e. ratio of the number of students in any section to the number of staff teaching the section,
- 6) The university overhead factor variable,
- 7) The graduate student factor, and,
- 8) Assisted research.

In the study, therefore, the average cost per

student is equal to faculty salary load times faculty instruction factor times student load divided by faculty instruction work load times average class size. This expression employs the five policy variables, and can be used as a management tool to control the cost of undergraduate programs.

At the graduate level, the factors affecting instruction costs are similar to those at undergraduate programs, except that it is not possible to define student load, since course work for these programs normally is not structured. As class size can be measured easily, no attempt was made to analyse graduate student instruction costs, since the authors believed that much data would be needed to establish instructional hours taken by each student. Graduate supervision costs vary directly with the graduate student factor defined above.

Table H-1, taken from the Appendix to the Ring of Iron study makes it possible to observe, a) the extent to which different policy variables affect costs, and b) the range of variation of the different policy variables. It is interesting to note that only average class size

varies nearly to the same extent as do total unit costs for undergraduates. The authors ran a regression relating undergraduate total unit costs and average class size. This regression gave rise to a hyperbola with a correlation coefficient of 0.89%.*

The second most significant policy variable is the faculty instruction factor, followed by the faculty salary load and the faculty instruction work load variables.

The dominant impact on graduate student costs, excluding assisted research, was the graduate student factor.

It is interesting to note that this study utilizes staff-contact hours as the unit for distributing academic expenditures. It is indicated that staff-contact hours are preferred to student-contact hours for this purpose, because of the importance of the course

* Total Cost per Student = $64.7 + \frac{41,700}{\text{average class size.}}$

Table H-1

POLICY VARIABLES — UNIVERSITY AVERAGES
1969-70

No.	Policy Variable	Affects Unit Costs	Units	Averaged Over	Year	Ontario Average	Maximum	Minimum	Maximum Minimum
1.	Faculty Salary Load	Directly	\$ per F.T.E. staff	11 Universities	All	25,845	39,049	15,000	2.6
2.	Faculty Instruction Work Load	Inversely	Contact Hours per F.T.E. staff	11 Universities	All	293.96	495.89	157.71	3.1
3.	Faculty Instruction Factor	Directly	%	37 ¹ Departments	All	39	59	15	3.9
4.	Student Load	Directly	Student Hours per Year	11 Univ. ² 10 Univ. 9 Univ. 9 Univ. 11 Univ.	I II III IV All	734 652 673 691 689	819 736 769 801 819	637 514 583 574 514	1.3 1.4 1.3 1.4 1.6
5.	Average Class Size	Inversely	No. of Students per Instructor in Class	11 Univ. 11 Univ. 9 Univ. 9 Univ. 11 Univ.	I II III IV All	51 32.8 21.3 19.9 32.3	116.4 63.8 36.5 31.8 116.4	25.9 7.5 12.9 10 7.5	4.5 8.5 2.8 3.2 15.5
6.	University Overhead Factor	Directly	%	11 Univ.	All	30 ;	38	21	1.8
	Total Unit Cost Undergraduate		\$ per Student	11 Univ. 10 Univ. 9 Univ. 9 Univ. 11 Univ.	I II III IV All	1,110 1,670 2,140 2,450 1,820	1,960 6,080 3,360 4,020 6,080	360 700 1,170 1,080 360	5.4 8.7 2.9 3.7 16.9
7.	Graduate Student Factor	Directly	%	37 Departments	All	70	79	62	1.3
	Total Unit Graduate Excluding Assisted Research	Instruction Graduate Supervision Total	\$ per Student	37 Departments	All	1,090 9,460	2,410 14,860	90 3,860	26.8 3.8
					All	10,550	17,000	4,370	3.9
8.	Assisted Research	Directly	\$ per Student	35 Departments	All	6,350	20,420	1,600	12.8
	Total Unit Cost — Graduate Including Assisted Research		\$ per Student	35 Departments	All	16,900	35,290	8,100	4.4

¹37 departments had graduate students in 1969-70.²Of 11 universities one offered years I and II only, and one offered year I only.

in the explanation of the costs. The authors recognize that this approach is not entirely correct, and that the true basis for distributing costs would be a combination of both staff-contact hours and student-contact hours, as the number of students enrolled in a course does have some implication on the costs of the course.

In summary then, this study by Messrs. Thompson and Lapp, in addition to providing for a very interesting description of costs in engineering programs, is an interesting attempt to build policy simulation capabilities into the model.

It grossly simplifies the allocation of overhead cost problems and makes assumptions which provide the analysis with theoretical neatness and nicety. In the end, it may prove to be as useful as the more complicated and untidy approaches, such as that of the A.U.C.C.

The K factor is particularly interesting, though it suffers from linearity assumptions. The study is also useful in that it brings to the fore the impor-

tance of class sizes and courses in explaining cost differentials.

V. CONFERENCE OF RECTORS AND PRINCIPALS OF QUEBEC
UNIVERSITIES COST STUDY*

Professor Segal's study of instructional costs in 1968-69 in one social science and one science department at each McGill University and the Université de Montréal was designed as a pilot study to test the feasibility of an analytical cost model, rather than a descriptive one, such as those in the Calgary Cost Study and the A.U.C.C. Cost Study.

Segal develops an accounting framework to estimate actual or planned production relations and costs of production of university programs, as well as component activities. His study is limited to a consideration of human resources inputs that perform the instructional activities of teaching, leading discussion groups, supervising laboratories, and correcting students' work. He tests the adaptability of his accounting framework in explaining the costs of new teaching systems, and in doing

* M.D. Segal, The Political Economy of Resource Distribution in Quebec Universities, Conference of Rectors and Principals of Quebec Universities, November 1970.

so, has developed a very disaggregated accounting framework which calls for detailed information concerning teaching activities. Such detail was necessary to make possible simulations of new teaching systems, and the testing of the cost sensitivity and quantitative importance of many changes in pedagogic procedures.

I shall not comment on Segal's discussions of the university production function in the context of social welfare, nor on his discussion of the nature and requirements of systems analysis or of the policy value of the accounting system.

Segal identifies the components of the instructional system as inputs and outputs. The inputs organize into activities which are the basic elements of programs. These are lectures, tutorials, labs, corrections, etc.*

Though he differentiates teaching activity into

* Segal acknowledges the arbitrariness of the classification. One might wish to consider lectures, labs, etc. as somewhat analogous to the institutional context into which inputs (student and professor time) enter, and from which outputs are generated (i.e. changes in the cognitive affective and other attributes of students and professors).

the categories of preparation, delivery or discussion, administration and assessment, his analysis deals only with regularly scheduled contact hours. Segal uses the formal instructional unit (FIU) as the unit of analysis. He defines an activity as a sub-unit comprised within an FIU. If an FIU were to be a course consisting of lectures and conferences, then the lectures and conferences are activities. If the formal FIU is a seminar which meets regularly, then the FIU has one activity, and the FIU and the activity are the same thing. The correcting of papers at a fee is a separate activity for an FIU. However, correction of papers by teachers does not in Segal's model constitute a separate activity. A combination of FIU's is a program. Figure 5 illustrates layout of the accounting framework. Each symbol utilized is identified in the appropriate columns. The way in which outputs are calculated from the inputs is identified with the formula appropriate to each output in the respective columns. Segal distinguishes the following inputs and outputs:

(a) Inputs:

1. Activities:

(L) Lectures

- (A) Labs
- (C) Conferences
- (D) Discussions
- (S) Seminars
- (M) Separately financed administrative duties specific to classes
- (E) Separately financed evaluation duties specific to classes.

2. Time:

- (1) The total number of weeks over which the activity is carried in the year
- (2) The sequence of student participation in the session (For example, whether the student attends sessions weekly, every two weeks, monthly, etc.)
- (3) The duration of each class
- (4) The number of sessions each student is expected to attend per sequence.

3. Students:

- (7) The number of students enrolled in each activity
- (8-9) The number of enrollees participating in the activity at one time.

4. Staff:

- (13) The identification number of the person teaching each activity
- (14) His academic rank
- (15) His gross salary, excluding fringe benefits, per hour or per annum, whichever applies.

(b) Outputs:

1. Physical:

- (5) The number of hours per sequence that each student attends each activity
- (6) The number of hours per annum that each student attends each activity
- (11) The number of teaching hours needed per sequence for each activity
- (12) The number of teaching hours needed per academic year for each activity
- (17) The percentage of the teacher's load spent on each activity.

2. Financial:

- (18) The total cost per annum of carrying the activity
- (19) The unit cost per student per annum for each activity
- (20) The cost per hour of teaching for each activity
- (21) The cost per hour per student attending each activity.

3. Auxiliary:

- (22) A weighting factor to be used for analysis of the variance in cost per staff member per hour.

Segal makes use of an FIU enrolment matrix;

r	d_1	d_2	d_3	E	<u>Fields</u>		
1	300	400	200	900	$r_1^{d_1}$	$r_1^{d_2}$	$r_1^{d_3}$
2	250	150	200	600			
3	75	100	125	300	$r_2^{d_1}$	$r_2^{d_2}$	$r_2^{d_3}$
4	50	100	150	300			
TOT	675	750	675	2100	$r_4^{d_1}$	$r_4^{d_2}$	$r_4^{d_3}$

The r 's denote the number of FIU's taken from any one department, and the d 's represent the different disciplines. E is enrolment. In the matrix $r_3^{d_3}$, indicates that it is expected that 125 students enrolled in d_3 will take three FIU's in the department being accounted. Each element linking an "r" and a "d" is a program field. He then develops formulae to compute the average number of enrollees from the department, and from other departments, by FIU. His accounting framework is developed to calculate the departmental costs, the unit costs per enrollee, the cost per major discipline, etc. The accounting framework is also concerned with the number of groups taught (see Figure 1 column 10), the number of staff-contact hours required per sequencing period (see columns 5, 10, 11), the number of contact hours per year (see column 12), the teachers' instructional load, which when divided into the contact hours per annum provides the number of teachers

required (see columns 12 and 17), the salary costs of the activity (see columns 16 and 17), unit costs per student (see column 19), unit costs per contact hour (see column 20), and unit cost per hour per student in the activity. He also develops a weighting factor (see column 22), the purpose of which is to derive the weighted average number of students per contact hour per teacher, which he suggests is a better measure of the relationship between student numbers and teachers than the more traditional staff-student ratio.

It is to be noted that these concepts are applied to very disaggregated units, namely activities within FIU's.

Professor Segal made no attempt to segregate instructional from research activities. He uses the hours of instruction as a proxy measure, to include all aspects of teaching duties. In his discussion of work loads, Segal makes a hypothesis that the form of the relationship between research and contact hours over the

FIGURE 5.

Sample - Course Accounting Framework

11	12	13	14	15	16	17	18	19	20	21	22
Th	Th	Th	Th	Th	Th	Th	Th	Th	Th	Th	Th
2	26	1234	1	10%	10,000	.210	2500	7.94	96.13	.21	8190
(a/b)	a(Th.b.) or (c.d.)	Identity of professor	Professor rank	His total load in contact hours per year	Annual salary	No. spends .25 of his total load on this activity	(9c.d.) His costs to \$2,500.	(12/a) Unit cost per student in 8	(12/7a) Cost per hour of teaching	(12/7a) Cost per hour per student attending in this activity	Weighting factor

Lecture
 Laboratory
 Tutorial
 Correction
 Administrative Preparation

DEMO = Demonstrator
 TUTOR = Tutor
 CORRECTOR = Corrector
 PART-TIME = Part-time
 POST-DOCTORAL = Post-doctoral

FIG 4.1	1	2	3	4	5	6	7	8	9	10
Course "a"	a	b	d	e	f	g	h	i	j	k
Activity "y"	24	-3	1	2	2	24	313	313	-	1
Activity	The student attends every 2 weeks	Each lesson lasts 1 hour	Each student attends 2 lessons per "a"	(d.g) For the number of hours per "a" that each student in attendance at lessons	(e.h.h.) The number of hours per student attends the activity	Number of students enrolled	Participation per session all 313 sit at the same time	Ratio Student/Instructor in lab.	(2/1) The number of groups	

Range Col. 2, "a"

b = 1, occurrence = 3 week
 -3 = 2/2 weeks
 -47 = 1/10 days
 -23 = 1/month

Range Col. 10

1 = Full prof.
 2 = Associate prof.
 3 = Assistant prof.
 4 = Lecturer

1 =
 2 =
 3 =
 4 =
 5 =

full range of contact hours is negative and non-linear.^{*} Negative because the more time consumed in teaching, the less time will remain to conduct research and non-linear, because of the hypothesis that there are economies of scale in teaching, that is, course preparation, administration and evaluation increase less than the proportion of the student number of contact hours.

Professor Segal's procedures, therefore, involve two major simplifications, assuming only two activities, teaching and research, and avoiding joint input and output situations.

Professor Segal then develops cost analysis procedures to explain absolute and relative cost differences in costs per student per hour per course. He chooses this unit of comparison initially because it informs on relative costs that are not simply the result of their

* It is interesting to examine this hypothesis in parallel with that of the Thompson-Lapp Study, where it is assumed that each graduate student requires a fixed number (K) of hours of annual supervision, excluding formal instruction.

being more or less students taught over more or less hours. He also examines the determinants of unit cost per student, and total cost at different levels of aggregation. He develops formulae to arrive at weighted average values of unit cost per student per hour per FIU, and unit cost per student, weighted to ensure that FIU's which have very few students will not count with the same weight as those which have many students. He then constructs tables (e.g. Figure VI), the first section of which is a statement of the absolute values of the averages per FIU by level and by department for each variable. The second and third sections provide the same information, but in an index number form to permit comparison between variables that have different unit properties. The first of these index number tables facilitates comparisons of change in the value of each variable from one FIU level to another within each department. The second index number table facilitates comparison of change in the value of variables from one department to another for the department as a whole, and at each FIU level. For example, for variable 2, grand mean of department Y is 110 in respect to the grand mean of department X: level 200 FIU's in department Y have a value of 107 in

FIGURE VI -- GRAPHIQUE VI

ILLUSTRATION OF INDEX NUMBER COMPARISONS
EXEMPLES DES COMPARAISONS DES INDICES DE COUTSA. Intra-departmental; inter-level:
Coûts relatifs par niveau dans un département:

Department "X":

Département "X":

	v_1	v_2		v_n
Grand Mean/Moyenne générale	130	105		
Level/Niveau 100	100	100		100
200	110	105		
300	118	92		
400	124	130		
500	130	101		
600	145	97		

B. Inter-departmental:
Coûts relatifs par niveau entre départements:

Department "X":

Département "X":

	v_1	v_2	v_n
Grand Mean/Moyenne générale	100	100	100
Level/Niveau 100	100	100	100
200	100	100	100
300	100	100	100
400	100	100	100
500	100	100	100
600	100	100	100

Department "Y":

Département "Y":

	v_1	v_2	v_n
Grand Mean/Moyenne générale	105	110	115
Level/Niveau 100	110	113	118
200	99	107	109
300	122	114	118
400	133	94	87
500	141	118	131
600	145	122	127

respect to level 200 FIU's in department X.

He discusses the a priori relationships between average cost per student per hour, average cost per student, and total cost. Then he makes comparisons by level, discipline, department and university, of unit costs per student per hour, of unit costs per student per FIU*, of student contact hour commitments per FIU, and of total costs and FIU enrolment.

Segal demonstrates that his very disaggregated FIU activity units make it possible to simulate the costs of very novel pedagogic procedures. His model was constructed with that purpose in mind.

It should be noted that his study is partial, in that it says nothing about other instructional activities, capital investments, space allocation and costs, support services such as non-academic staff, administration, library, audio-visual, and other equipment. It is

* Similar to the Thompson-Lapp analysis of the relationship between total costs per student and average class size.

however useful in that it can serve, as does the Thompson-Lapp model, to examine the implications of different policy decisions. In the study, Segal develops the analysis to describe changes in average cost per student, for changes in any of a number of variables. Figure VII indicates the nature of the analysis. In the cost constraint table, line 1 is the starting point of the exercise, with the present unit cost per student (notation p in the C U column, at \$7.94). Its corresponding input information is listed in columns 6, 7, 8, 15, and 16, the resulting outputs are listed in columns 10, 12, 17, and 18. Assume that the policy is to cut C U (unit cost per student) in half, that is, to \$3.97. This is noted on line two in the C U column, and the results are derived from formulae for each variable input. The way to interpret line two is as follows: Costs would be cut in half if students attend thirteen rather than twenty-six hours per annum, ceteris paribus. This might also happen if class sizes were increased from 315 to 630 per session, ceteris paribus. An increase in work loads from 104 to 208 hours would produce the same results. This might also be obtained if professors' salaries are modified from \$10,000 to \$5,000. Line three of the cost constraint

FIGURE VI

COST CONSTRAINT TABLE

	INPUTS				OUTPUTS			
	6	7	8	15	16	10	12	17
CU	Pe	e	z	x	SA	input	Ta	Pt
P	7.94	630	315	104	10000	SA	2	5
d	3.97	-	630	208	5000	x	k	k
		1260	630			z	k	.250
						z	26	.250
						z	26	.250
						Pe	26	.250
						SA	k	k
	9.52	k	k	k	12000	x	k	.417
d	7.94	21.67	378	125	12000	z	k	k
						e	k	k
						Pe	k	.417
							43.4	5000

CU : P
 CU_d : d
 CU_a : n
 CONSTANT : k
 ONIT : -

table illustrates new values of enrolment (E), and student participation per session (Z), the results of which cut unit cost per student by half. The right-hand section of the cost constraint table indicates the effects on output variables for a change in each input variable. Inputs are listed down the input-output column, and are the same as those listed in section 1 of the table. To read the effect on output variables of a change in any one input, locate an input variable in the input column, and read the changes in outputs across that line. Values are calculated from manipulation of formulae, which can be found in Appendix II of Segal's study. For example, to read the effect on output variables for a salary change i.e. a diminution from \$10,000 to \$5,000, read across line 2 columns 10, 12, 17, through 18. Nothing changes except total cost which is reduced from \$5,000 to \$2,500.

Most of the formulae assume linear relationships, but there is no doubt that further analysis to determine the real nature of such relationships is sorely needed.

In Appendix III, Segal discusses the effect of changes through time on unit costs of changes in program structures, FIU structures, FIU enrolments, faculty work loads and faculty salaries on unit costs. Though quite superficial, it is the only systematic discussion of the dynamics of costs change in the studies reviewed.

In summary then, Segal's study is very partial, and was developed mostly as an analytical tool for analysis of policy changes. He has not been concerned with the major problems faced in the other studies, i.e. teaching/research dichotomies, time studies of professors, imputation methods to allocate costs from various functions towards cost units, etc. The interest of his model is its use to simulate and cost different pedagogic methods. It indicates a need for very micro cost centers for this purpose. The other studies examined (except for the Thompson-Lapp Study) were more concerned with descriptions of costs, and as such were more satisfied with more aggregative cost data. The appearance of computers would, however, seem to make it important to develop and utilize very micro cost centers, for it is possible to aggregate

starting from disaggregated data, the reverse being impossible. However, the nature and the difficulty of various allocation of cost problems between different budget units is undoubtedly much more difficult, and perhaps illusory at this level of disaggregation.

VI. SYSTEMS RESEARCH GROUP COST AND BENEFIT STUDY OF
POST-SECONDARY EDUCATION*

This study makes use of a fully developed cost benefit analysis model and examines the income redistribution implications of post-secondary education, taking into consideration universities, community colleges, teachers' colleges, nursing schools, and agricultural colleges. The cost analysis makes use of private, social, direct and opportunity costs, institutional and student costs by level, diploma costs, program costs, including those with hospital components such as dentistry, medicine, and nursing.** The model is analytical and has interesting simulation capabilities. No new data was generated for this study.

1. Characteristics of the Cost Analysis Model.

Programs were costed by academic year and by degree. This was done as follows:

- 1) A trial balance of institutional and societal costs was constructed to illustrate the breakdown of finan-

* Systems Research Group, Cost and Benefit Study of Post-Secondary Education in the Province of Ontario, School Year 1968-69, April 1971.

** See the glossary of terms and the discussion below for definitions.

cial commitments between the institution and society.

- 2) Institutional and societal costs per student were broken down by program and by academic year.
- 3) Estimates were made of institutional degree costs by program.

In the trial balance accounting system, there are two quasi-systems, institution and society. The society account is broken into three categories, in which expenditures are attributed to students, government, and the rest of the economy. The trial balance gives a general picture of the existing financial interrelationships between the institution and society and its sectors, and among the sectors themselves. Transactions between society and the institutions consist of operating and capital grants from governments, fees from students, and grants derived from various other funds, such as endowments and from the re-imbursement of current deficits. Within the society's account, student receipts are derived from student financial aid awards of institutions, from student financial aid transfers from government, and from transfers from the rest of the economy. The expenditure categories utilized in the trial balance accounts are as follows:

1. Government Operating Grants
2. Gifts for Operating Purposes

3. Student Fees
4. Student Academic Equipment
5. Ontario Student Aid Program Grants
6. Ontario Student Aid Program Loans Expenditures
7. Ontario Graduate Fellowships
8. Gifts for Student Financial Aid
9. Institutional Student Awards
10. Direct Student Awards
11. Institutional Net Expenditures
12. Government Capital Grants
13. O.U.C.A.C. Financing
14. Mortgage Financing
15. Other Financing
16. Campaign and Capital Gifts
17. Depreciation
18. Repayments to O.U.C.A.C.
19. Other Repayments
20. N/A
21. Government Refund of Sales Tax
22. Government Operating Grants
23. Government Capital Grants
24. Gifts
25. Loss of Tax from Gifts
26. Ontario Student Aid Program Grants and Fellowships
27. Ontario Student Aid Program Loans Expenditures
28. Direct Student Awards
29. Loss of Tax from Direct Awards
30. Student Fees
31. Student Academic Equipment
32. Loss of Tax on Student Expenditures
33. Foregone Student Annual Earnings
34. Loss of Tax on Student Foregone Earnings
35. Institutional Employed Capital
36. Loss of Corporation Tax
37. Loss of Property Tax.

The trial balance accounts provide a comprehensive picture of all direct (monetary) and opportunity costs associated with post-secondary education.

The study generates four types of cost analysis from the trial balance:

- 1) The private costs of a particular educational program. This includes all direct and opportunity costs incurred by students or their families who attend post-secondary educational programs,
- 2) Institutional cost per student per year, by program,
- 3) Social cost per student per year. These are the combined social and private costs (direct and opportunity costs) associated with each program,
- 4) Institutional expected degree cost for Undergraduate, Master's and Doctoral degrees in all programs. These consist of the institutional cost per year modified by the conditional probabilities of passing each year of a program successfully, until graduation.

As indicated in the preliminary comments, this cost analysis model is completed by a most interesting income redistribution effects model which we shall not discuss. This involves among other operations, breaking down societal costs of each educational program by trial balance sheet cost category, and identifying each cost category according to components of the society account which are responsible for the funding. Each of the components of society account is further disaggregated to show the total contributions of five income classes by program. These provide the total contributions of the five income classes to the cost of each higher education program.

The following definitions of the cost accounts were used in this study:

- 1) Direct Costs: These are the costs which represent actual expenditures which have occurred and been paid in the time period under consideration (1968-69).

a) Institution

The institutional direct costs consist of expenditures on

- i) student awards
- ii) expenditures on salaries and operating expenses
- iii) expenditures due to depreciation, such as replacement of assets (5.7% rate assumed - building life: 40 years, equipment life: 5 years).

b) Students

Student expenditures consist of

- i) tuition costs
- ii) equipment expenditures

c) Government

Government expenditures consist of

- i) operating grants
- ii) student aid program covering grants, loans and fellowships (the cost of maintaining - this is assumed to be 6 1/2% of total loans)
- iii) capital grants and capital financing
- iv) rebates of sales taxes (4% of new construction)

d) Rest-of-the-Economy

Private business expenditures consist mainly of gifts to the institution, either through large private donations or through alumni funds. This holds true only for universities, as no gifts were indicated for the other institutions.

- 2) Opportunity Costs: These are costs which do not appear in

conventional accounting records and do not entail actual dollar outlays. They represent the earnings that might have been realized if the assets currently used in post-secondary education had been applied to some other (presumably more profitable) alternate use. (It is assumed that the opportunity rate on all costs was 7%).

a) Institution

The institution opportunity costs are associated with the possible returns from the Institutional Employed capital (land, buildings, funds). (tax rate assumed to be 50%).

b) Student

Student opportunity costs consist of foregone interest on tuition and equipment expenses as well as foregone earnings. (Tax on foregone student earnings assumed to be 10%).

c) Government

Government opportunity costs consist of foregone interest on all of its direct costs as well as foregone taxes on the opportunity costs of the other sectors of society and the institution. (Foregone municipal taxes were assumed to be 2% of land, buildings and equipment).

d) Rest-of-the Economy

The opportunity costs in this sector consist of foregone interest on gifts made.

It is interesting to note that costs of sponsored research are excluded, although as indicated later, simulations are presented which do consider sponsored research explicitly. The instruction versus research cost problem was not examined in this study.

The study makes estimates of institutional and societal costs per year, per student, by program, for undergraduate students, and graduate students.* A comparison of the cost per student, assuming that he passes each year, with the cost per graduate, reflects the cost added by failures, transfers, etc. to the cost of producing a graduate program.

One section of the study focusses on the cost of programs with hospital components. As indicated in the introduction to this study, we shall not discuss it.

We are told that almost all the institutions' specific cost data was distributed among the various programs by the Ontario Operating Grant Formula Weights. It is indicated that the use of the formula is a proxy for a thorough cost and accounting analysis, and that its use precludes obtaining marginal costs "as they would, in fact, not vary except in the case of emerging universities where extra formula allowances prevail."**

* Costs are calculated for full-time equivalent student enrolment. A conversion factor of 5 or 6 part-time students to one full-time student was used.

** Since actual expenditures in universities are not necessarily made in accordance with formula weights, it seems to me that marginal costs could well differ from average

The reliance on formula weights which were obtained by what has been called an indirect approach which consists in:

"Noting current and research operating grants, which we have reason to believe are not grossly inadequate and through a process of trial and error, finding a set of categories and weighting numbers that conform," ***

This prompts me not to pay much attention to the monetary costs indicated in the analysis, for these are obtained from weights which themselves are based upon a very poor accounting data base in universities, and from simulations at the total university level. I hasten to add that this in no way detracts from the methodological contributions which this study makes to cost accounting in post-secondary education.

Another interesting aspect of the S.R.G. study is the sensitivity analysis which is prepared. Simulations were prepared to test the effects of various combinations of economic growth per capita, ability of the student, consumption benefits, migration and the discount rate on net

costs depending upon scale of operations. One of the major criticisms of the Ontario formula financing approach is that actual cost functions are not linear and that coefficients, which do not vary with size (except for the emerging institutions) either under or over finance certain institutions.

***Memo from D.T. Wright to Dr. H.W. Taylor, Mr. J.R. McCarthy, Mr. J. McCarthy, The Honourable D.H. Porter, Professor A.N. Bourns, July 4, 1965.

present values and benefit cost ratios for males in selected occupations. Table V entitled Sensitivity Analysis indicates the results of the experiments upon the computational results of the model.

The S.R.G. Study examines by simulation the results of removing all sponsored research costs from the cost analysis.* This study then presents the impact on total institutional, governmental, student costs of removing first 25% and then 50% for research:

"It can be seen that government and rest of the economy costs are reduced almost in direct proportion to the research costs, except for those components depending on opportunity costs. The institutional, student and societal cost reductions are

* They recognize that there is still a large component of moneys devoted to research implicitly through university staff appointments, where time is allocated for research for various reasons - to keep professors abreast of their field, to improve course content, to train graduate students, to enhance the reputation of the institution, etc. The authors indicate the rationale behind the choice of the somewhat arbitrary amounts is that the average undergraduate teaching load is approximately 3 undergraduate courses plus preparation time. The balance of time is devoted to research. The courses and preparations typically consume 20 to 30 hours of a teaching week, leaving approximately 10 to 20 hours for research. The mixed graduate and undergraduate teaching load is typically one undergraduate to one graduate course, thesis supervision, and the balance research. From these general guidelines, it would appear that 25% and 50% are reasonable limits on the research expenditures.

TABLE V
A
SENSITIVITY ANALYSIS

VARIABLE	EXPTS	CHANGE	R/R	NPV	B/C
Discount Rate	5/10	+ 7%	0	-M	-400%
Ability	4/10	+40%	-30%	-38%	- 30%
Consumption	1/9	+10%	+25%	+25%	+ 20%
Growth Rate	9/10	+2.7%	+35%	+250%	+200%
Migration	2/9	-10%	-30%	- 25%	- 15%

B

EXP'T	RATE OF DISCOUNT	ABILITY VARIABLE	CONSUMPTION VARIABLE	GROWTH	MIGRATION
1	0	0	0.1	0	1
2	0	0	0	0	0.9
3	0	0.2	0	0.027	1
4	0	0.4	0	0.027	1
5	0.07	0	0	0.027	1
6	0.07	0.4	0	0.027	1
7	0.10	0.4	0	0.027	1
8	0.10	0.4	0	0.027	1
9	0	0	0	0	1
10	0	0	0	0.027	1

not in proportion due to components not affected by research expenditures. The universities have large holdings in lands and buildings, and the opportunity costs on these are not affected by research allocations, except perhaps in the case where sales of unneeded research facilities occur. The student's costs are least affected, because most of his costs are in the form of foregone earnings, and societal cost variation reflects the student cost contribution." (S.R.G., p. 113).

The following are some of the limitations of the model, and recommendations for further work suggested by the authors:

- 1) More relevance and detailed information to be obtained by visiting institutions.

It should be recalled that Professor Segal came to the same conclusion, and visited the institutions involved to obtain as much homogeneity as possible in the data. It should be remembered, however, and the A.U.C.C. study is testimony to this, that visiting universities will not solve the problem of poor and inappropriate data systems within institutions.

- 2) Costing on all programs reflecting actual contact hours spent by students in each of the years.

The recognition of foregone earnings makes this suggestion more important. It may be that if one is only concerned with institutional outlays, that staff

contact hours are of more interest in explaining costs,

- 3) A clearer definition and differentiation between moneys actually received or spent, and funds committed,
- 4) Better definition of expenditure and cost categories,
- 5) Better information on pass-fail rates,
- 6) Scale analysis to investigate the factors determining costs, so that marginal cost curves be estimated.

The authors have demonstrated that a consistent methodological approach can be formulated to generate comparative costs, and redistribution and benefit statistics of post-secondary education. In my estimation, it is the most advanced document on the subject. The data base on which it is based, however, is of the nature of that described by A.U.C.C., and it suffers, therefore, the same limitations. The use of formula weights to distribute costs by program is also a limitation. One of the interesting extensions which might be made to this model is to extend it to cover activities of manpower, immigration, health and welfare departments, which in many respects are intimately involved in the process of human resources formation.